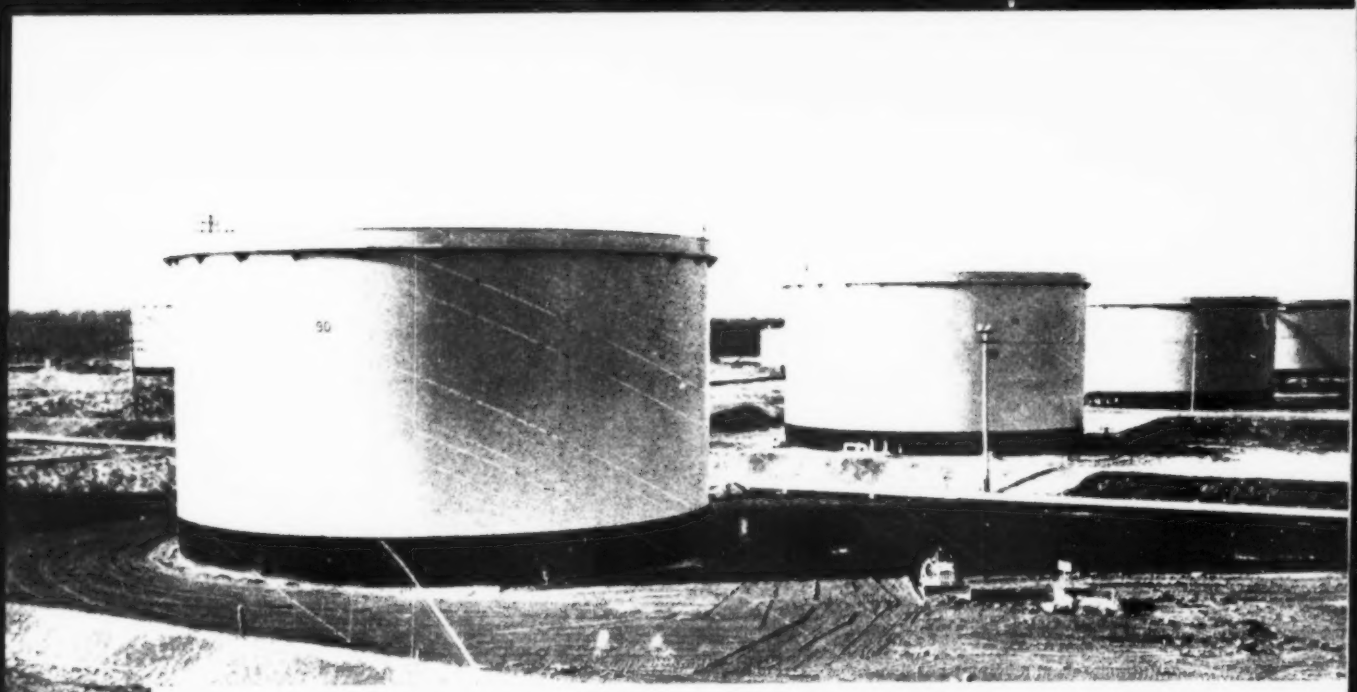
Speed Your Reading

Use the "Quick Look" on page 1

PETROLEUM REFINER



Modern storage equipment is a necessity in today's petroleum refineries. Inefficient handling and storing of volatile hydrocarbons can be costly. Positive protection against evaporation losses is provided by tanks equipped with Horton Floating Roofs and Horton Seals.

A Horton® Floating Roof floats directly on the surface, with its bottom deck normally in contact with the liquid in the tank. There is no air-vapor mixture above the liquid to be vented and lost. The Horton Seal, standard equipment on all Horton Floating Roofs, closes the space between the deck of the roof and the shell of the tank and assures the utmost in efficiency. Fire hazard and corrosion are also reduced as a result of the elimination of the vapor space.

Horton Floating Roofs are built in three types: Double-Deck, Pontoon and Pan. Write our nearest office and let us help you select the type most suitable to your operation.

CHICAGO BRIDGE & IRON COMPANY

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston
Los Angeles • New York • Philadelphia • Salt Lake City • San Francisco • Seattle • Tulsa

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY, and GREENVILLE, PENNSYLVANIA

IT FLOATS ON THE LOAD! *

You turn on the steam.

This little stainless steel valve—the only moving part in the Yarway Impulse Steam Trap installed on the equipment—opens wide and *stays* open as the air and condensate continuously pour through.

The equipment reaches production temperature in the quickest possible time.

Production temperature reached, the little valve snaps shut. After that, by a pulsating action, it discharges all condensate as it forms—even a tiny teaspoonful. *There's hot steam in the equipment all the time* . . . steady, maximum temperatures are maintained.

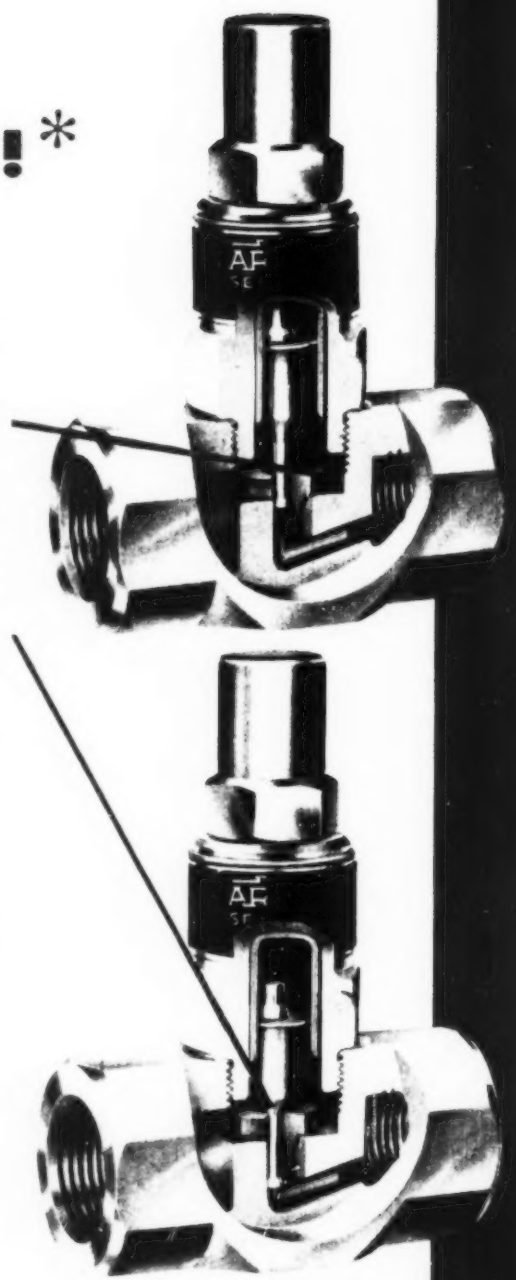
It all adds up—to more production per day.

Other profit-making features of the Yarway Impulse Steam Trap—low initial cost, easy installation, stainless steel construction, low maintenance, good for all pressures, quick delivery from over 200 local industrial distributors.

Try a Yarway—free for 60 days—and *prove* its advantage. Your distributor will supply you.

For free Yarway Impulse Steam Trap Bulletin T-1740, write . . .

YARNALL-WARING COMPANY
128 Mermaid Ave., Philadelphia 18, Pa.



* . . . *resulting in fast heat-up of equipment, more production per day.*

YARWAY | ***impulse steam trap***

Volume 33, No. 2 February, 1954

Designing Stripping Columns 96
N. H. Prater
Calculate Capacities of Perforated Plates 99
Frederick A. Zenz
Calculating Engineering Economics, I 103
Douglas S. Sherwin
Refiner Lays 1954 Plans 106
Put Gas Jet Compressors to Work 107
George R. Fletcher
Second Ammonia Plant for Shell 112
Shale Oil—What Is It? 113
G. U. Dinneen
Speed Spectroscopic Analyses 116
John H. Jordan, Jr.
Tonnage Oxygen, III 117
Peter W. Sherwood
Pipe Flexibility Calculations 123
R. G. Blick
How Chemical Cleaning Makes Money 131
J. T. Browning
Centrifugal Compressor Performance 133
S. R. Steinbock
Imperial To Revamp Maritime Refinery 136
Natural Gasoline Analysis 137
S. T. Preston and Dan E. Smith
Quick Measurements with Portable Thermowell 140
R. G. Sanders, Jr.
Petrochemicals Reactions, 9 141
Lewis F. Hatch
Simplify Refinery Calculations 145
Louis J. Murphy
Statistical Quality Control 149
John T. Walter
Pipe Stress Calculations 153
A. M. Peiser and S. Katz
Vapor-Liquid Calculations 156
Royes Salmon
Chamber Coking at NCRA 157
J. W. Ward and J. M. Holecek
Taking Stock 160
Cecil W. Smith

As Management Sees It

Are You Paying Too Much Income Tax? 92
A. C. Aikman
Don't Drug Employe Incentive! 232
F. M. Butler
Sizing Up a Job Candidate 240
Auren Uris
The Courts Say 244
Joseph M. Shelton
Better Health for Executives, II 246
Dr. B. B. Reeve
Shortage of Managerial Talent Critical, I 248
W. C. Eldridge
This Actually Happened 250

DEPARTMENTS

Quick Look 1-2
Bob's B.S.&W. 3
Letters 87
Look Box 89
Who's Building 95
Meet Our Authors 182
How to Do It 186
What's Happening 178
Advertised Products 196
Manufacturers' Literature ..... Insert, 198-197
New Equipment 197
Equipment Literature 218
Who's Meeting 222
Calendar of Meetings 228
Reviewing New Books 228
Suppliers Notes 251
Index to Advertisers 258

PETROLEUM REFINER
REFINING | PETROCHEMICALS | NATURAL GASOLINE

A Quick Look at This Issue

Designing Stripping Columns for Petroleum Fractions . . . Here is a rapid method for calculating the steam requirement and number of stages for economic studies of optimum design. It is not necessary to choose arbitrarily a number of stages in the design of strippers. Here is a simple, reliable and proven method. **Page 96.**

How to Calculate Capacities of Perforated Plates . . . This style of distillation tray was first patented many years ago but only very recently has been commercially developed. As with all modern devices, there are many technical cobwebs to be swept away. Here is a really topnotch contribution to the literature that will do just that. For some hitherto unpublished information, turn to **page 99.**

Calculating Engineering Economics, Utility Costs . . . One of the most vexing tasks encountered in engineering economics is that of estimating utility costs. An excellent simplification of the problem is presented in this article. The author leads the reader through a shortcut method which guarantees a reasonable answer in the minimum time. **Page 103.**

Put Gas Jet Compressors to Work . . . Gas jet compressors can use the energy stored in high-pressure gas to compress low-pressure gas. And in many instances their use offers big savings for pipe line operations. For how it's done, turn to **page 107.**

Shale Oil—What Is It? . . . To answer this question the author discusses the analysis of ten U. S. and ten foreign shale oils. He points to the identifying characteristics, variation in composition and the factors affecting composition. **Page 113.**

Speed Your Spectroscopic Analyses . . . The rapidly increasing use of spectroscopic analyses has created a serious problem in maintaining clean glass sample containers. The device described here solves this problem by (1) cutting washing time; (2) removing contaminants, and (3) eliminating contact with hazardous cleaning chemicals. **Page 116.**

An Auxiliary to Petrochemical Processing—Tonnage Oxygen . . . This is the concluding article in a three-part series covering all phases of oxygen manufacture. Part III is concerned with complete

descriptions of some of the types of "package" units. In addition to descriptions, the author has included cost data on the various units. You will want to keep this article for future reference. Turn to **page 117.**

Pipe Flexibility Calculations . . . Here is a new technique for calculating a very tedious problem—pipe flexibility in multi-plane bends. Presented in cookbook fashion, the method involves just simple arithmetic and no reference to any formulas whatever is required. **Page 123.**

How Chemical Cleaning Makes Money . . . You probably won't find a worse cleaning job than described in this case history. For six years a toluene unit had laid idle. To reactivate it, refinery maintenance had to come up with a method which would clean equipment that was heavy with layers of adhering iron oxide. For how they solved the problem, turn to **page 131.**

Analyze Centrifugal Compressor Performance Graphically . . . How many times have you bought a compressor for certain design conditions only to find that the operating conditions are vastly different? Then you had to follow tedious mathematical formulae to determine the new operating variables of the compressor. Well . . . your problems are over! Here is a method which will require only two minutes for the solution. And you can calculate new speeds, new pressures, new temperatures, new horsepower requirements. Or you can calculate combinations of two or more of these variables. **Page 133.**

Natural Gasoline Analysis . . . By this rapid method, liquid residues from natural gasoline analyses can be analyzed for vapor equivalent, molecular weight and liquid/gas ratio. The method is also accurate—giving results accurate to three significant figures. **Page 137.**

Quick Measurements with This Portable Thermowell . . . Here is a portable thermowell which permits quick and easy temperature measurements at any point where a drain or bleeder valve is located. This thermowell has been successfully tested in lines having pressures of 200 psig, and could probably be used at even higher pressures. **Page 140.**

Alcohols from Olefins . . . This is Part 9 of the "Understanding the Chemistry of Petrochemical Reaction" series. Here is a thorough discussion of the alcohol manufacturing industry in this country. The various processes for making alcohols from olefins are included as well as production figures for the major alcohols. **Page 141.**

Use These Charts to Simplify Refinery Calculations . . . The charts described cover many phases of refinery and petrochemical plant design and have proven themselves to be excellent time savers during any planning work. They are also helpful to plant operators desiring to check values in the field. So if you wish to save time and effort, learn to use these charts. **Page 145.**

Statistical Quality Control . . . No longer a long-haired mathematical tool, statistical quality control has really arrived for the refining industry. In this article you will find how this tool was used on a fractionating tower to reduce product quality variability and to lessen the number of process adjustments. It can also mean a reduction in the laboratory budget by decreasing the number of control samples on the schedule. **Page 149.**

Pipe Stress Calculations . . . Just turn the crank and out come pipe stress calculations by the dozens. It's not quite that easy, but automatic computers can cut calculation time to less than eight hours on a typical pipe system involving six constraints and one hundred pipe sections. **Page 153.**

Simplified Vapor-Liquid Calculations . . . Another short-cut method which will save the process engineer valuable time in these usually tedious calculations. This method enables the calculation of the amount of vapor and liquid in equilibrium at a given condition with only one column of divisions for each trial calculation. The number of trials are reduced substantially if you use the graphical control method recommended by this process engineer. **Page 156.**

Chamber Coking at NCRA . . . The National Cooperative Refinery Association has a process unit to brag about. This unit incorporates four unique features in its design: once through process design, maximum use of existing visbreaking equipment, gantry crane coke handling system, and an unusual decoking water system. **Page 157.**

Don't Drug Employe Incentive . . . The will to work, greatest support beam of American freedom, is being undermined by so-called employe benefits. The American worker is being drugged into the worst condition possible—that of expecting to receive without giving. If you don't want to listen to some blunt talk about a spreading evil, then skip over **page 232.**

Sizing Up a Job Candidate . . . Executive A, after 15 minutes of talk, has a clear understanding of the job applicant he is interviewing. Executive B, after an hour of conversation, has gotten nowhere. Why the difference? It's all in the interviewing technique. Does your interview have a pattern? If not, turn to **page 240** for some helpful information.

Shortage of Managerial Talent Critical . . . Industry realizes this more keenly each year as more and more retirements are deferred and as the executive turnover increases. This problem is one of four major phases in executive development—particularly the development of engineers. **Page 248.**

Next Month . . . .

Where's the Fire?

At Pan American Refining Corporation at Texas City, Harvey B. Williams, director of safety and fire protection, and other plant officials decided it would be helpful to have basic information between two covers on how to guard against and combat fires in a given installation.

Williams ascertained that other companies had no such a manual—"but would like to!"

They'll get their wish.

Next month PETROLEUM REFINER will present the first installment of a series by Williams that will tell you:

- How to prevent a fire.
- How to extinguish a fire.
- How to prevent a fire from spreading.

RAY L. DUDLEY, Publisher
A. L. BURNS, General Manager
DR. JOHN J. McKETTA, JR., Editorial Director
ROBERT J. PHILLIPS, Editor
GEORGE B. GIBBS, Editor, Process and Construction
DON S. RAWLINGS, JR., Petrochemicals Editor
WM. G. DUDLEY, Equipment Editor
AL REESE, Editor, Management and Personnel
CECIL W. SMITH, Economics Editor
ROBERT E. SPANN, Eastern and Foreign Editor
GILBERT M. WILSON, Western Editor
DR. LEWIS F. HATCH, Contributing Editor
SILAS B. RAGSDALE, Managing Editor
DAVID G. WILLIS, Editorial Assistant
LEVA A. MALCOLMSON, Librarian

Specialized Oil Publications of
THE GULF PUBLISHING COMPANY
Box 2608, Houston (1), Texas
PETROLEUM REFINER and The REFINERY CATALOG for the refining-natural gasoline-petrochemical industry
WORLD OIL (formerly The Oil Weekly) and The COMPOSITE CATALOG for the drilling-producing-pipe line industry

TOM W. NELSON, Advertising Manager

Advertising Representatives
GENE HART, GEORGE SKELTON, 250 Park Ave., New York 17, N. Y.
H. G. FITZPATRICK, MARTIN HALLORAN, 332 S. Michigan Ave., Chicago 4, Ill.
J. W. CURTS, W. W. Wilson Bldg., Huntington Park, Calif.
BILL WESTFALL, 1010 Euclid Ave., Cleveland 15, Ohio
BILL ATCHESON, Hunt Bldg., Tulsa 3, Okla.
CHARLES WYATT, CLAIR BRYAN, JR., 3301 Buffalo Drive, Houston 19, Texas
D. S. CRAIG, Mgr. Advertising Service Dept.

Circulation Department
R. M. DE SOMBRE, Manager
Box 2608, Houston, Texas

Single copies 50 cents (except special issues) for U. S. and Canada; $1 for all other countries. Subscription rates: U. S. and Canada $2 a year; Latin America and overseas $5 a year. PETROLEUM REFINER, published on the 12th of every month, entered as second class matter June 16, 1923, at the post office at Houston, Texas, under act March 3, 1879. Advertising rates on application.

Copyright 1954 by The Gulf Publishing Company.

Petroleum Refiner is Indexed by Industrial Arts Index, Chemical Abstracts and by Engineering Index, Inc. Microfilm copies available through University Microfilms, Ann Arbor, Mich.

Bob's B. S. & W.

Every editor needs a little corner where he can pour out his soul—speak up on personal convictions that may not bear the dignity of a full fledged editorial, tell pridefully of the accomplishments of his magazine, poke fun at the funny situations encountered through the unusual nature of his job. This column, then, is the REFINER's Fibber McGee closet, the collection of the potpourri—the B.S. & W.—of our publishing efforts.

Bet on the Winner. For those of you who follow the fiercely American tradition of loving a winner, here is an unusual story. In all its 32 years, the REFINER has managed to stay ahead of its petroleum publications competitors. But within the last 12 months, something has happened. The race has become unequal and none of the highly interested people in these offices can furnish a really lucid explanation. Our circulation has gone stark wild. The net paid circulation has increased a truly phenomenal 20.6 percent in the last 12 months, which by previous standards would have been a very satisfactory increase for a full five years! In our business, which is far more qualitative than quantitative, it's hard to put a finger directly on the reasons. We know of course, that in the final analysis, it can be traced to more and better reading material.

Lo! the Poor Engineer! It has become quite the journalistic fad to dissect psychologically the engineer, with the answer always pretty depressing. Our various analysts invariably find that we are sort of queer jerks, introverts to the very core, poorly trained by our colleges to accept our social responsibilities, unfit for managerial positions, and unequal to our civic obligations. We've had about enough of this baloney!

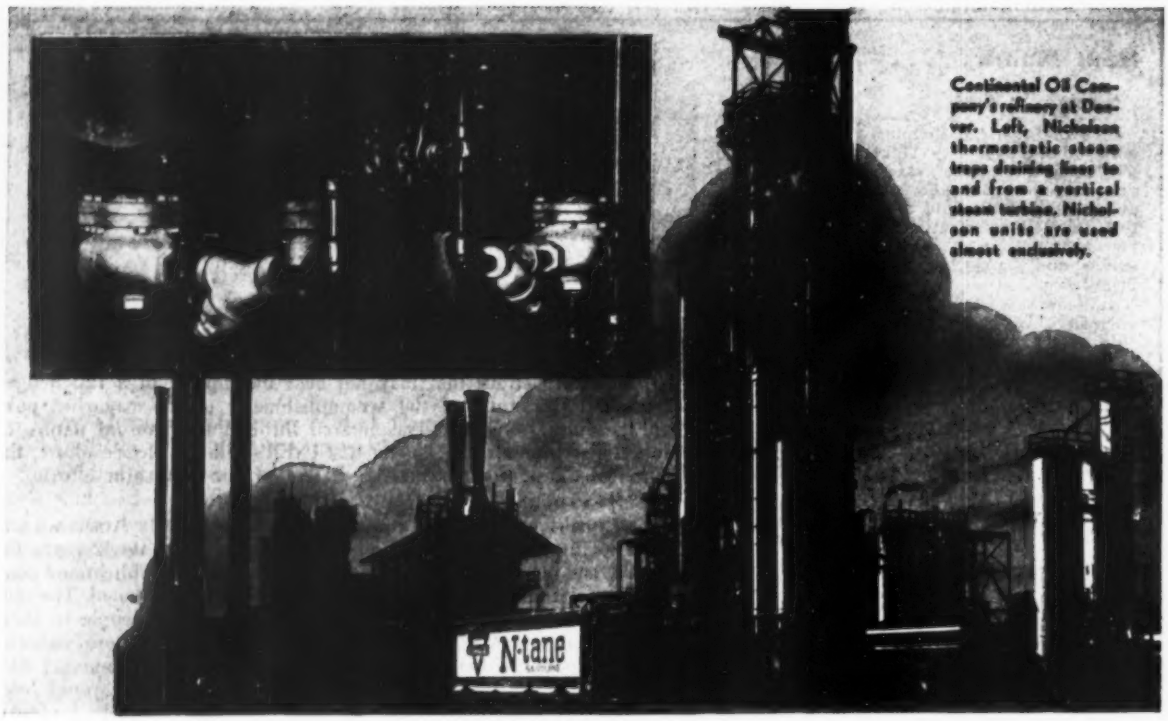
We think engineers are just plain old garden variety Americans who have long been making a contribution to the welfare of society far out of proportion to what they have demanded in return.

A normal cross section of normal American boys elected to study engineering in college. Then came World War II and it became clear that if the Allies were to efface the disadvantages of geography and enemy manpower, they must excell in production. Here the engineer came to the fore, hit a mighty lick, and now America is clearly the world's leader in unit productivity. This has prompted all sorts of characters, from psychiatrists to editors, to take notice of these quiet little workers and wonder what makes them tick. Result: a shower of written words that generally reflect no great credit on the engineer as an individual.

What about this business of teaching engineers more of the humanities in college? Right now, the engineer is sweating like a turk to complete his technical studies in 4½ years. To do so, he spends about twice as much time in class rooms and laboratories as his academic counterpart. The faculties of the colleges are under constant pressure from industry to add more technical courses to the curricula—instrumentation, nuclear energy, ad infinitum. Where does the time come from to be used for additional courses in the humanities when our engineer is already working twice as hard (and spending a year longer) to get a degree that will entitle him to something less than the income of a bricklayer when he first leaves his halls of learning?

We think it's time the heat was taken off the engineer. We size him up as an average citizen, with above average devotion to his work, who is equally as qualified as any other broadly defined group in his executive potentials and response to society's obligations.

—*Bob Phillips*

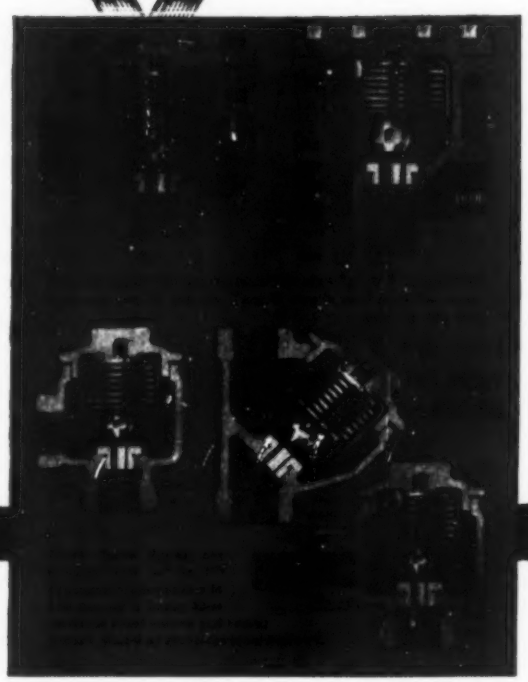


Continental Oil Company's refinery at Denver. Left, Nicholson thermostatic steam traps draining lines to and from a vertical steam turbine. Nicholson units are used almost exclusively.

NICHOLSON TRAPS SELECTED for CONOCO Refinery

This Continental Oil Company refinery has adopted Nicholson steam traps because they proved most effective generally in improving heat transfer. This is an advantage which, we believe, is important to plant men in every industry. A recent survey showed these Nicholson features to be the reasons why plants with standardization-for-economy programs are increasingly adopting Nicholson traps: (1) Two to six times average drainage capacity. (2) Operate at lower temperature differential. (3) No air binding. (4) Freeze-proof. (5) Only one moving part. (6) No change of valves for varying pressures. (7) Record low for steam waste. For process, power, heat.

Send for CATALOG 953



NICHOLSON

TRAPS · VALVES · FLOATS

207 OREGON ST., WILKES-BARRE, PA.

Sales and Engineering Offices in 38 Principal Cities

TARGET OF OUR EFFORTS

Prompt attention to orders . . .
Exact compliance with specifications . . .
Rigid adherence to delivery dates . . .
Means **CUSTOMER SATISFACTION** —
The one consideration that governs
policy and practice at
PATCO
FOR SERVICE AND RELIABILITY

PACIFIC TUBE COMPANY
specializes in the manufacture of tubing from stainless, carbon and alloy steels. Patco produces cold drawn seamless tubing, welded tubing, and cold drawn bars. Write for our catalog.

PACIFIC TUBE COMPANY
5710 SMITHWAY STREET,
LOS ANGELES 22, CALIFORNIA
WEST COAST REPRESENTATIVES FOR
SUPERIOR TUBE COMPANY, NORRISTOWN, PA.

patco

Which of these 22 tube steels will give you maximum tube life per dollar? *Ask the experts!*

This month's report is on: **2% CR.-MO.**

Has intermediate corrosion resistance in combination with good creep strength and fair resistance to oxidation. For use at temperatures up to 1200° F. in cracking coils, reforming units, heat exchangers, vapor line and hot oil piping, and return-bend forgings for oil heaters.

ONE OF 24 TIMKEN HIGH TEMPERATURE STEELS

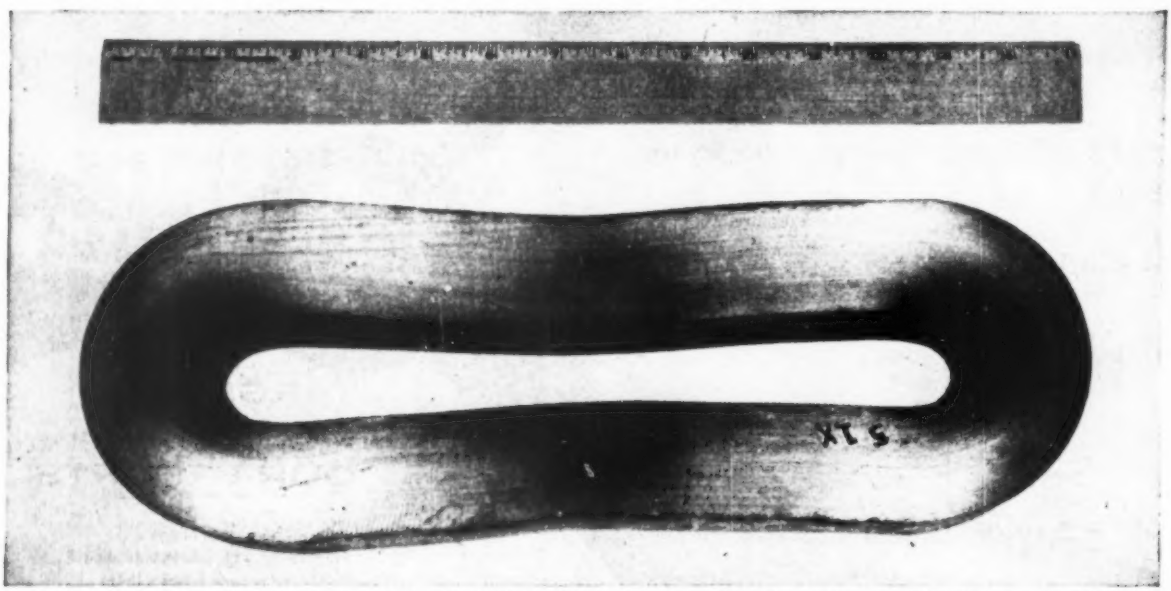
Carbon	Sicromo 2	Sicromo 5S	18-8 Ti
Carbon-Mo.	Sicromo 2½	Sicromo 5MS	16-13-3
DM-2	2½% Cr.-1% Mo.	Sicromo 7	25-20*
Silmo	Sicromo 3	Sicromo 9M	25-12*
DM	4-6% Cr.-Mo.	18-8 Stainless	35-15**
2% Cr.-Mo.	4-6% Cr.-Mo.-Ti.	18-8 Cb	16-25-6**

** Available as seamless tubing on an experimental basis only.*
***Not available as seamless tubing.*

FOR every high temperature application, there's one tube steel that gives you the best life-cost ratio. One steel best answers your particular set of temperature-pressure-corrosion-oxidation conditions. That's why the Timken Company makes the 24 different high temperature steels shown in the box at left.

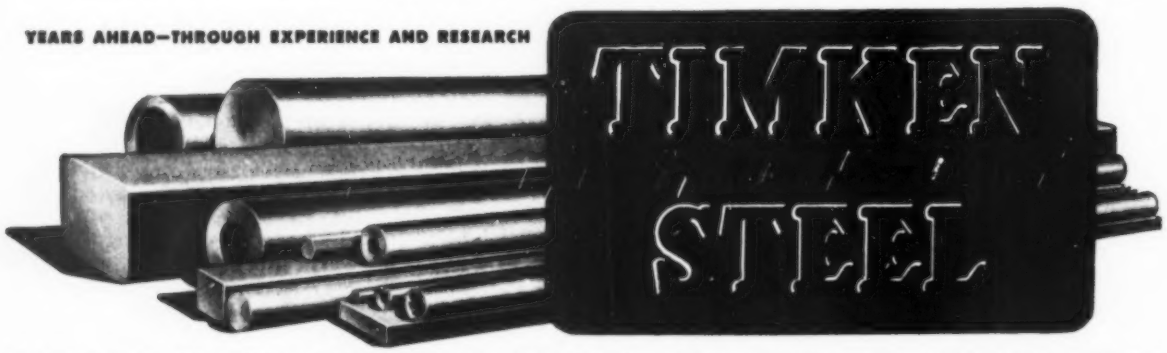
To find the one best steel for each of your applications, ask the Timken Company metallurgists. They're experts. They know how to balance the various factors against cost—and recommend the analysis that gives you maximum tube life per dollar of cost. They've been doing it for 20 years. And remember—regardless of analysis, you get uniform quality in every Timken® tube because we rigidly control quality at every step from melt shop through final inspection.

Put our "RSQ"—Research, Supply, Quality—to work on *your* tube problems. *Ask the experts!* The Timken Roller Bearing Company, Steel & Tube Division, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".



Flattened test of 10½" O.D. by 1.580" wall of 18-8 Cb showing the excellent ductility of large, heavy-wall Timken seamless tubing.

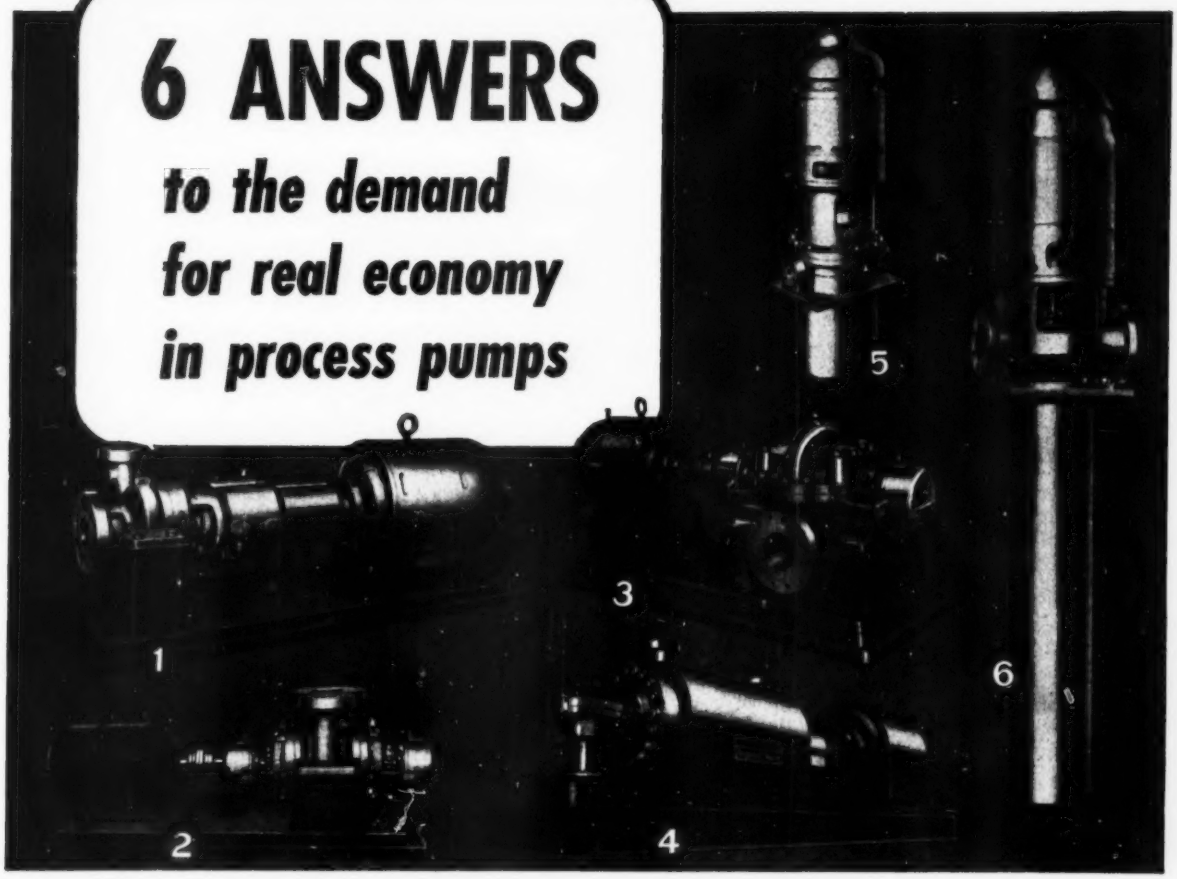
YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH



SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING

6 ANSWERS

to the demand for real economy in process pumps



These six types of Ingersoll-Rand process pumps offer you important savings in most refinery jobs.

For most refinery and process plant applications, there's an Ingersoll-Rand pump that is right for the job. This means more than just meeting design conditions – it means construction of the *right* materials and the *right* sealing arrangement, with either the Cameron Shaft Seal or an adaptation of a packed stuffing box. These and other points of pump know-how can only be gained through years of field and design experience – experience which Ingersoll-Rand has had in over 50 years of service to the petroleum industry.

Let your nearest I-R representative give you the details on the real economy of I-R pumps – high sustained efficiency, economical operation, and low maintenance.

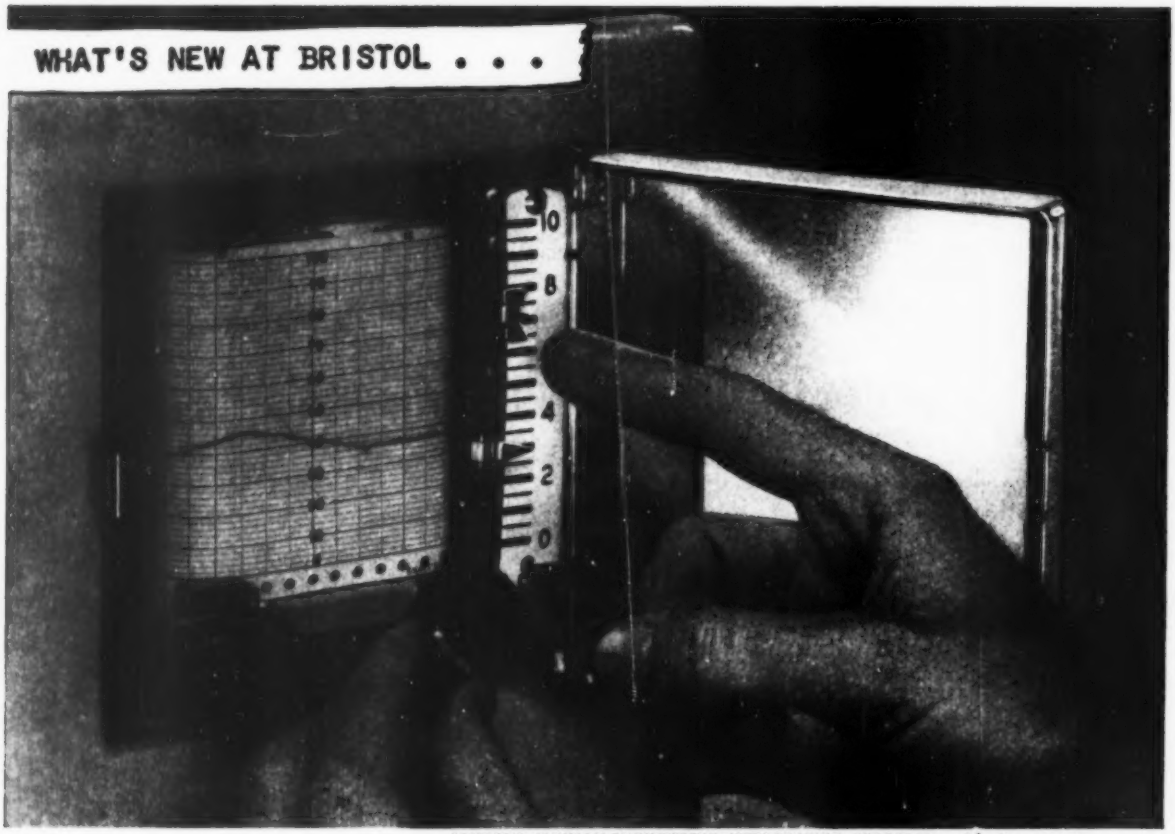
	PUMP TYPE	STAGES	CAPACITIES	HEAD
1	Vertically split with top (or bottom) suction and discharge or end suction and top discharge	Single stage	20 to 3200 gpm	Heads to 600 feet
2	Vertically split with top suction and discharge	Single stage	250 to 3500 gpm	Heads to 1100 feet
		Two stage	200 to 1200 gpm	Heads to 1100 feet
3	Horizontally split with side suction and discharge	Single stage	30 to 2300 gpm	Heads to 750 feet
		Two stage	170 to 1300 gpm	Heads to 1100 feet
4	Diffusor type with "double-case" construction. Top suction and discharge.	Multi stage	450 to 3000 gpm	Heads to 6000 feet
5	Vertical pump, diffusor type	Multi stage	20 to 400 gpm	Heads to 4800 feet
6	Vertical pump, turbine type	One or more stages	60 to 35,000 gpm	Heads to 150 feet per stage

Compressors • Air Tools • Rock Drills
Turbo Blowers • Condensers • Centrifugal Pumps
Diesel and Gas Engines

Ingersoll-Rand

11 Broadway, New York 4, N. Y.

589-10



BRISTOL'S "HUMAN-ENGINEERED" METAGRAPHIC RECORDER, with its easy-to-read scale, high-visibility fluorescent pointers and shadow-proof door has earned the distinction of being the "biggest little instrument in the business."

Instrument men call Bristol's METAGRAPHIC Recorder

"... the biggest little instrument"

Sounds contradictory, but it's true. Take a look at one of our new METAGRAPHICS mounted on a panel board alongside of other instruments. The Bristol unit stands out – seems bigger than the rest – although chances are it's actually smaller (5" x 5¾"). The answer is that the Bristol instruments have been "human-engineered", making them easy to read, and clearly visible at greater distances.

The air-operated METAGRAPHIC, which records pressure, temperature, vacuum, flow, differential pressure, and liquid level, offers these big advantages:

SIMPLICITY . . . fewer moving parts, fewer adjustments, and less service required. Range changes can be made in seconds. True plug-in service.

CONTINUOUS VALVE-POSITION INDICATION . . . separate from set-point indication, gives continuous data on control valve position and level of process operation. No switching is necessary in order to get reading.

CONTINUOUS OPERATION . . . complete unit can be retracted for inking pen, and for set-point and zero adjustment without disturbing record or control. Auto-manual switching is foolproof and "bumpless", without disturbing valve position.

Get the whole story on the "human-engineered" METAGRAPHICS – how they can help you get more accurate measurements, faster and easier. Write us today. The Bristol Company, 111 Bristol Road, Waterbury 20, Conn.

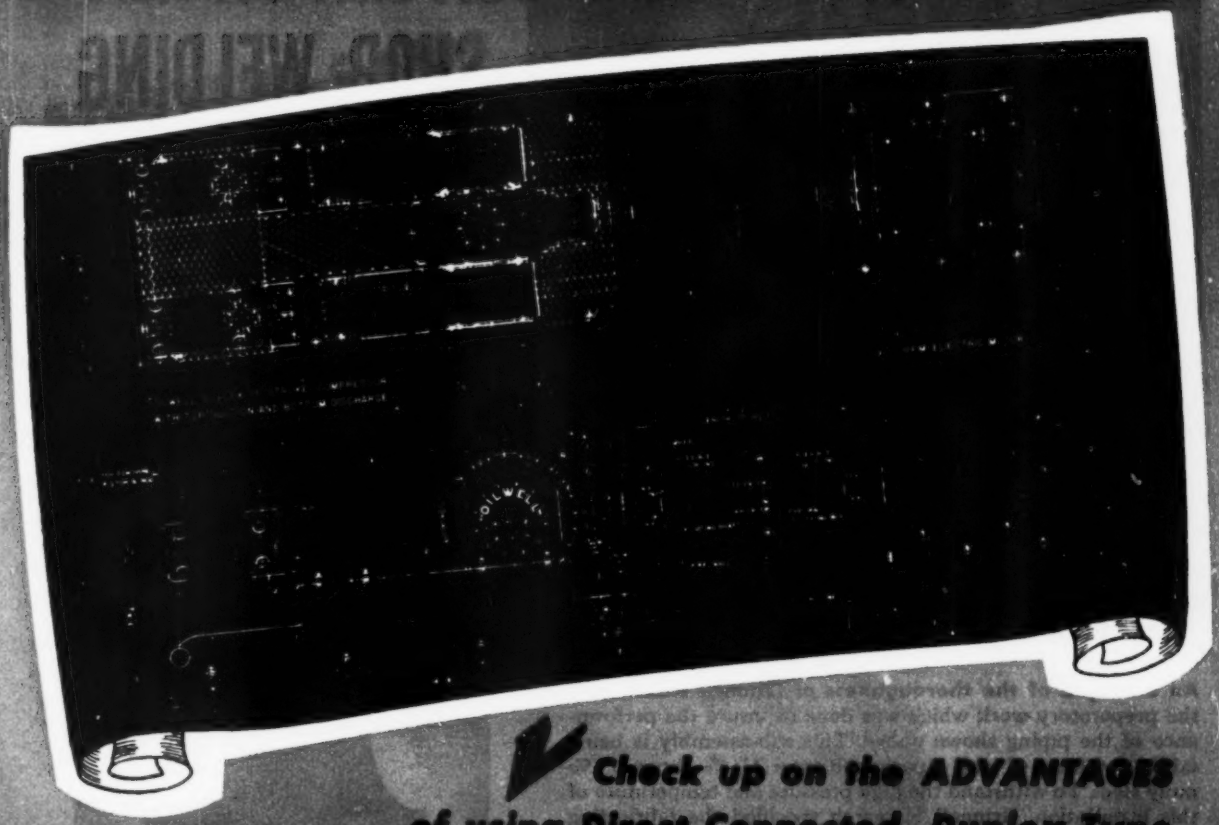
4.4

BRISTOL

POINTS THE WAY IN HUMAN-ENGINEERED INSTRUMENTATION

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

SINGLE or MULTIPLE Units!



Check up on the ADVANTAGES of using Direct-Connected, Duplex-Type

"Oilwell" Compressor Units

. . . for Gas Compression in Refineries

"OILWELL" UNITS of this type are slow speed; designed with direct drive through right-angle gears to two parallel compressors so as to utilize 300 hp. input from a single prime mover with maximum efficiency.

For applications in the larger-volume-low-pressure range, single-stage compressors can be furnished. Where higher pressures are required, multi-stage compressors can be furnished to develop discharge pressures to 3,000 p.s.i.

Installations in hazardous areas can be made with maximum safety, by incorporating a fire wall between unit and driver as indicated in the sketch.

Where gas concentrating operations exceed the capacity of a single compressor unit, multi-unit installations are highly practical because they permit the routine servicing of individual compressors when necessary without shutting down the entire operation.

Let your "Oilwell" Representative . . . quote on "Oilwell" Compressor Units to meet the gas-concentrating requirements of your refinery.

OIL WELL SUPPLY
DIVISION
UNITED STATES STEEL CORPORATION

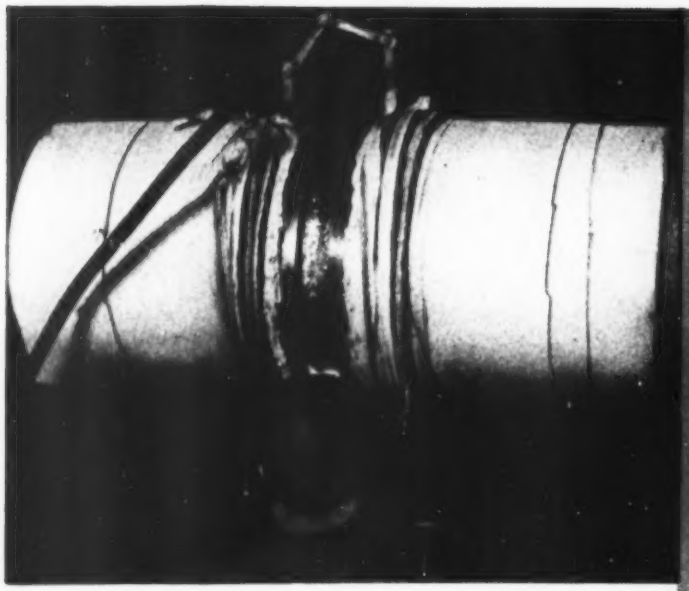
Executive Office—DALLAS, TEXAS
Export Office—
30 ROCKEFELLER PLAZA
NEW YORK 20, N. Y.

Area Offices — CALGARY, CANADA
CASPER, WYOMING . . . COLUMBUS, O.
DALLAS, TEXAS . . . HOUSTON, TEXAS
TULSA, OKLA. . . . LOS ANGELES, CALIF.

Branches Serving All Oil Fields

USS "OILWELL"

UNITED STATES STEEL



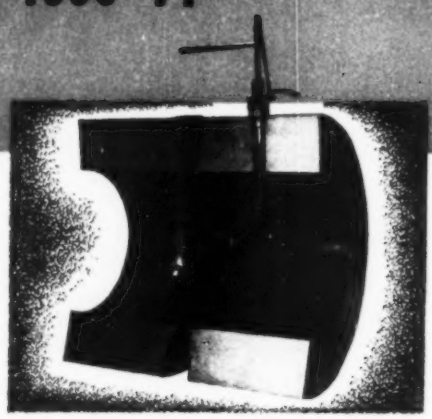
SHOP WELDING 4" WALL PIPE

for steam at 2050 PSI and 1050° F!

You can be confident of the piping fabricated in Grinnell shops, because Grinnell Research predetermines materials and methods, then checks results to insure that specifications are met exactly.

An example of the thoroughness of Grinnell Research is the preparatory work which was done to insure the performance of the piping shown above. This sub-assembly is being fabricated from 4" wall pipe forged from 2¼% chrome, 1% moly steel. To withstand the high pressure and temperature of this installation, Grinnell Research specified the fabricating and welding procedures to be used. This included the time and temperature cycles for preheating and stress relieving, and the correct type of electrodes.

Preliminary test welds on sample pipe were made. These were then cut apart and analyzed to check microstructure and strength of the weld, which had to have the same properties as the pipe itself.



A test piece of 4" wall pipe cut apart to show the quality of the weld. Also illustrated is the method used to introduce a radium capsule into the center of a completed assembly for radiographic examination of the weld.

Taking photomicrograph of specimen of a test weld.

During fabrication, the first inch of each weld was ground smooth and given a complete radiographic examination for possible flaws. Finally the completed weld was checked by radiographic examination.

It's intricate business . . . developing correct fabrication methods for new materials and services. It's one of the jobs for which Grinnell fabrication specialists are well qualified, because Grinnell has the equipment and modern methods, the interpretive engineering, the metallurgical research facilities and the skilled personnel to handle any prefabrication requirement.

GRINNELL

WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

Ask for This New 24-Page Bulletin on

ETHYLENE OXIDE
ETHYLENE GLYCOL
DIETHYLENE GLYCOL

Nitrogen Division offers you advance information, complete with technical data, on Ethylene Oxide, Ethylene Glycol and Diethylene Glycol. Soon available in tank cars and drums from the new Nitrogen Division plant at Orange, Texas, these organics will be produced by an improved process that assures high standards of quality and exceptional purity.

To expedite handling of your request for the Bulletin, please fill in and mail the coupon.

NITROGEN DIVISION
ALLIED CHEMICAL

Nitrogen Division
ALLIED CHEMICAL & DYE CORPORATION
40 RECTOR STREET • NEW YORK 6, N. Y.

Nitrogen Division
Allied Chemical & Dye Corporation
40 Rector Street
New York 6, N. Y.

Please send me a copy of your new Bulletin on Ethylene Oxide, Ethylene Glycol and Diethylene Glycol.

NAME _____

TITLE _____

COMPANY _____

STREET _____

CITY _____ **ZONE** _____ **STATE** _____

PR-2

Another Milestone... the

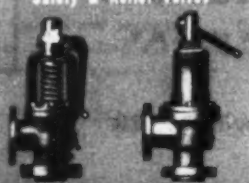
Farris

AFFILIATED COMPANIES

400 COMMERCIAL AVE., PALISADES PARK, N. J.

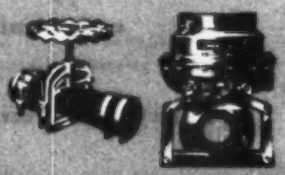
FARRIS ENGINEERING CORP.

Safety & Relief Valves

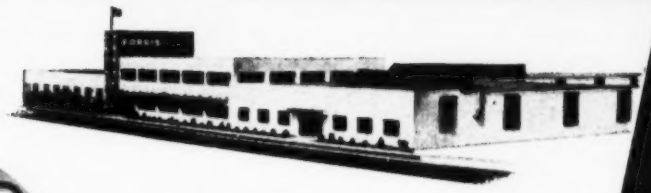


FARRIS FLEXIBLE VALVE CORP.

Pinch Type Flexible Valves



new home of Farris



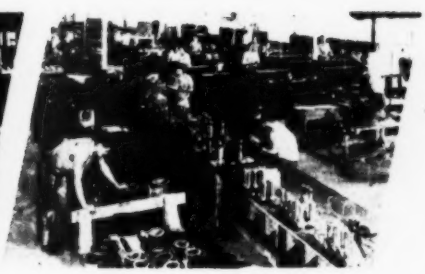
AFFILIATED COMPANIES

This plant, on a 4 acre tract, is more than an expansion, it is in fact a living thing . . . visual proof that growth in the American way is the simple result of straightforward, sincere effort in giving appreciative customers their money's worth.

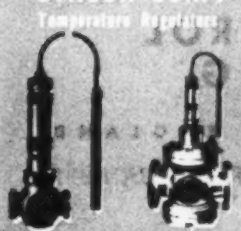
In this air-conditioned plant, equipped with the very finest of automatic machinery, we now feel that we have established another milestone; yes, a foundation stone from which our next decade of growth should stem.

Thanks to you, our customers and friends. Thanks to you, our staff, who have truly made the term man-power vibrant.

We shall always keep our operations simple and direct. This effort and thinking has been, and always will be, well rewarded.



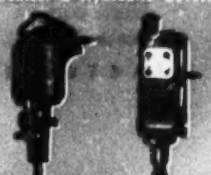
FARRIS STĀCON CORP.
Temperature Regulators



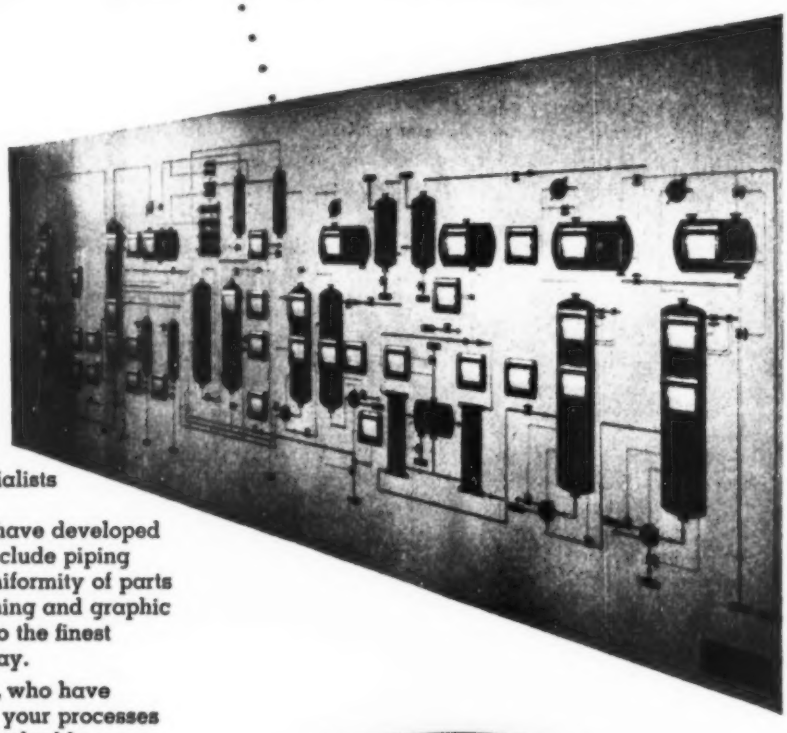
FARRIS HYDROTORQUE CORP.
Hydraulic Positioners

FARRIS HYDROSEAL CORP.
Elastic Piston Seals

FARRIS PICKERING GOVERNOR CO.
Mechanical & Hydraulic Governor



engineered GRAPHIC PANELS by FOXBORO



Working as a team, Foxboro Panel and Process Control Engineers offer you an unequalled resource . . . one which will assure you of the most efficient instrumentation, and the most practical panel layout, for your process.

Foxboro Panel Engineers are specialists in panel design and fabrication. Exclusive techniques which they have developed over many years of experience include piping arrangements, wiring methods, uniformity of parts and accessories, methods of finishing and graphic portrayal — all of which add up to the finest graphic panel work available today.

Foxboro Process Control Engineers, who have specified the right instruments for your processes over the years, are applying this valuable experience to the integrated control systems which you require today.

Whether we originate the graphic layout from your flow sheet, or work directly from a design of your own, this engineering teamwork will provide you with the ultimate in an operating panel for centralized process control.

If you are planning a new or modernized control room, let us detail a proposal for you, with comprehensive data on Foxboro Graphic Panels.

The Foxboro Company, 742 Neponset Ave., Foxboro, Mass., U.S.A.

FOXBORO
REG. U. S. PAT. OFF.

PROCESS CONTROL ENGINEERING

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

KEY MEN *at your Service in* KEY CITIES *representing*

TEX BENDER

J. F. Bechtle
7 EAST 42 ST.
NEW YORK CITY

T. G. Robinson, Sr.
Meters and Controls
444 N. LA SALLE ST.
CHICAGO

T. G. Robinson, Jr.
Meters and Controls
444 N. LA SALLE ST.
CHICAGO

D. W. Rutledge
317 CITIZENS BLDG.
CLEVELAND, O.

TEXAS PIPE BENDING COMPANY
INCORPORATED

PIPE BENDS
PIPE COILS
WELDED HEADERS

Pipe Fabricators
HOUSTON TEXAS

OFFICE AND PLANT
301 FRIO STREET
WEstworth 6605

Want Side-Mounted Handwheels for Small Sizes? For Large Sizes?

Get them on MASONEILAN Control Valves

10000 Series
Valve With
No. 6A2 Handwheel

This simple, sturdy, inexpensive type, continuously connected side-mounted handwheel provides for manual operation of all Masoneilan Control Valve sizes ¾" to 10" inclusive. It is made in three sizes to combine adequate power with compactness in each valve size range.

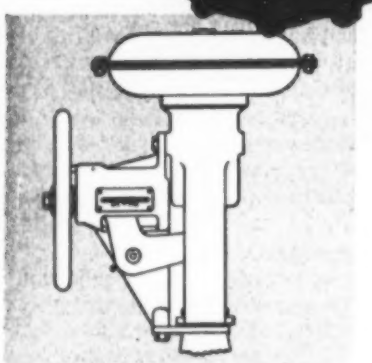
OPERATIONAL ADVANTAGES

- Offers convenience and dependability for emergency operation.
- Provides an adjustable limit stop in either direction.
- Permits replacement of diaphragm without shutdown.
- Is only convenient means for manual operation of reverse-diaphragm motors.

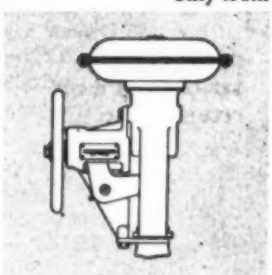
DESIGN FEATURES

- Continuously connected — requires no clutching device.
- Bellcrank and screw construction provides ample power for operation under all conditions — even against diaphragm pressure.
- Grease-packed radial and thrust bearings and Alemite bellcrank pin bearing insure ease of operation and long service life.
- Has simple flip-over fork lock to retain wheel when not in use.
- Provides mounting pad for auxiliary devices.
- Compact — *Does not increase overall height* of valve — adds only from 3¼" to 4⅜" to maximum overall diameter.

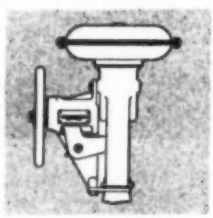
Ask our nearest office — or write — for details



No. 6A3
Valve Sizes 6" to 10"



No. 6A2
Valve Sizes 3" and 4"



No. 6A1
Valve Sizes ¾" to 2½"

MASONEILAN

MASON-NEILAN REGULATOR CO.

1182 ADAMS STREET, BOSTON 24, MASS., U. S. A.

Sales Offices or Distributors in the Following Cities: New York • Syracuse • Chicago • St. Louis • Tulsa • Philadelphia • Houston • Pittsburgh • Atlanta Cleveland • Cincinnati • Detroit • San Francisco • Boise • Louisville • Salt Lake City • El Paso • Albuquerque • Odessa • Charlotte • Los Angeles Corpus Christi • Denver • Appleton • Birmingham • New Orleans • Dallas • Seattle • Mason-Neilan Regulator Co., Ltd., Montreal and Toronto

The man who is never at his desk

The girl who answers the phone for one of Ethyl's automotive engineers must have a pretty frustrating job.

These men are almost never at their desk.

You see, helping bus, truck, and taxi-fleet owners get more efficient operation is not something you can do very well from an office swivel chair. So Ethyl automotive engineers spend the bulk of their time out in the field working closely with oil-company sales and technical people in their contacts with the service managers of fleets.

This offers two important benefits to refiners. Ethyl customers get quick and direct cooperation. At the same time, knowledge gained from direct contact with

(*Continued on next page*)

Printed in U.S.A.

The man who is never at his desk

(Continued from preceding page)

the field enables our laboratory people to keep research directed in the most productive channels.

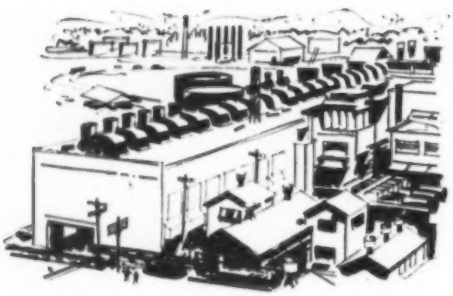
Our "get out in the field" operation is by no means confined to our automotive men in the field. Engineers from Ethyl's Research Laboratories are constantly at work with farm-tractor people, passenger-car builders, and airplane-engine manufacturers on developments that in the long run may prove important to gasoline refiners and distributors.

These hours our men spend away from their desks are the most valuable hours. They provide the first-hand knowledge and experience that enable us to give refiners the most effective assistance.

We feel—and we think you'll agree with us—that reliable technical service is an important ingredient in Ethyl antiknock service.

ETHYL CORPORATION
NEW YORK 17, NEW YORK

WORTH NOTING

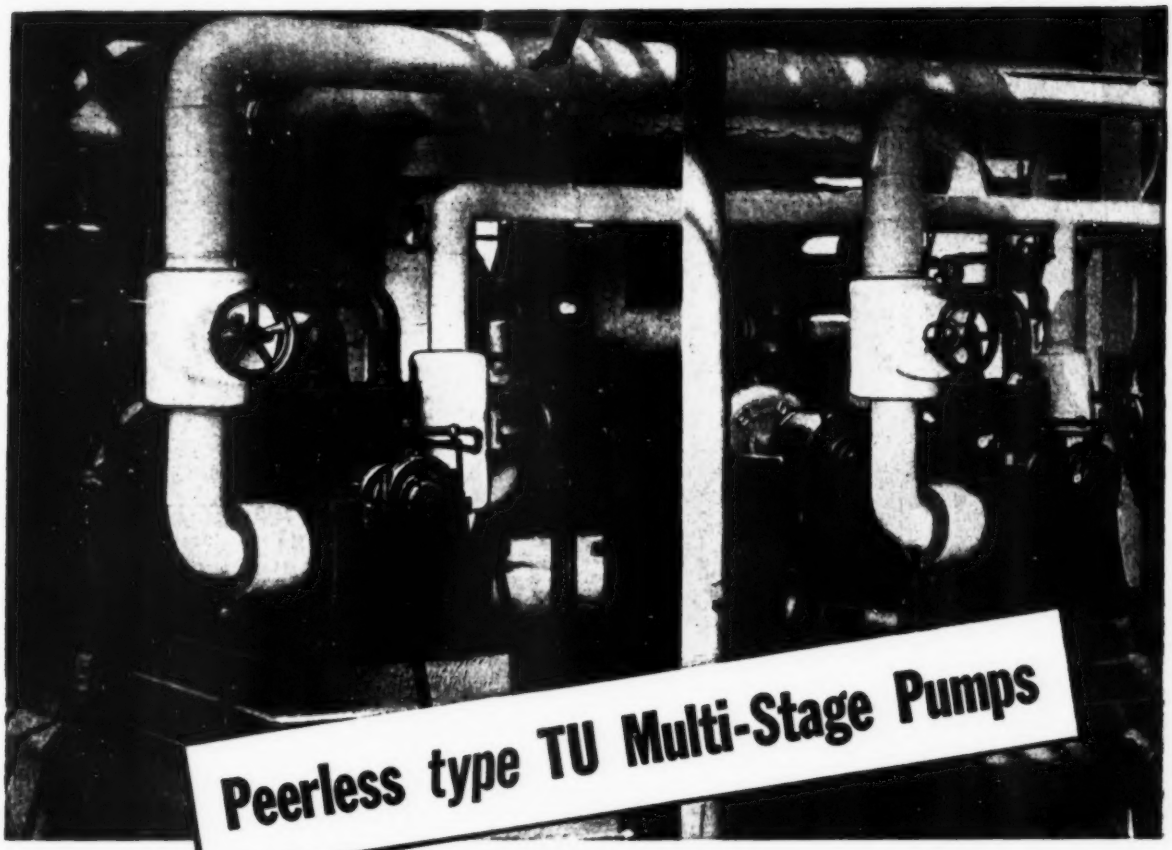


The largest sodium manufacturing facility in the world is part of the huge "Ethyl" antiknock compound plant at Baton Rouge, La.

31 years ago this month, the first sale of "Ethyl" gasoline was made in Dayton, Ohio. Ever since, Ethyl has continuously worked to expand the market for top-quality gasoline.

The "all weather" room at Ethyl's Detroit Research Laboratories can duplicate nearly any temperature, humidity and wind condition encountered in car operation.

Ethyl service is backed by 31 years of antiknock experience



Peerless type TU Multi-Stage Pumps

PEERLESS PUMPS

GENERAL SPECIFICATIONS

HEADS	Up to 1600 Feet
CAPACITIES	Up to 3000 GPM
TEMPERATURES	Up to 300°F
CASE PRESSURES	Up to 800 Lbs.
HP RANGE	Up to 325 BHP
DRIVES	All Types
CONSTRUCTION	Cast Iron, Bronze, Stainless

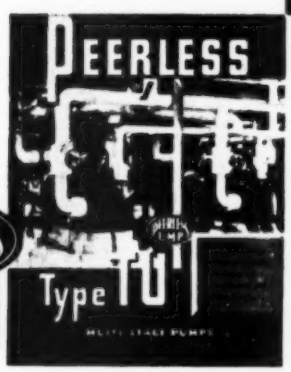
PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION

Address inquiries to Factories at: Los Angeles 31, Calif. & Indianapolis, Ind. *Offices:* New York; Chicago; Indianapolis; St. Louis; Atlanta; Tulsa; Plainview and Lubbock, Texas; Fresno; Los Angeles; Phoenix; Albuquerque, New Mexico.

Distributors in Principal Cities; Consult your Telephone Directory

4 COST-SAVING FEATURES OF THE TYPE TU LINE

- *SIMPLICITY IN DESIGN*
- *GOOD HYDRAULIC CHARACTERISTICS*
- *DURABLE, RUGGED CONSTRUCTION*
- *ON-THE-JOB DEPENDABILITY*



2, 3, 4 AND 5-STAGE PUMPS FOR SUPPLYING CIRCULATING AND BOOSTING WATER AND PROCESS LIQUIDS AGAINST MEDIUM AND HIGH HEADS. Put these dependable pumps to work for you. They'll deliver high maintained efficiencies over an extended service life. Their split-case design makes them easy to service and maintain. Their precision construction guarantees year after year durability. In all sizes 4" and under, cross over between stages is built integral with upper pump case. Over-size shafts, wear rings, shaft sleeves, heavy duty ball bearings, modern case and impeller design are outstanding features. Choose from many types and sizes for all head and capacity requirements.

PROFUSELY ILLUSTRATED BULLETIN. A new 4-color bulletin describes the Peerless Type TU pumps. It's complete with pump cross-section, dimensional drawings and load-capacity data. Use coupon below.

MAIL COUPON FOR NEW BULLETIN

PEERLESS PUMP DIVISION
Food Machinery and Chemical Corporation
301 West Avenue 26, Los Angeles 31, California

Please send a copy of TU Pump Bulletin No. B-1400 to:

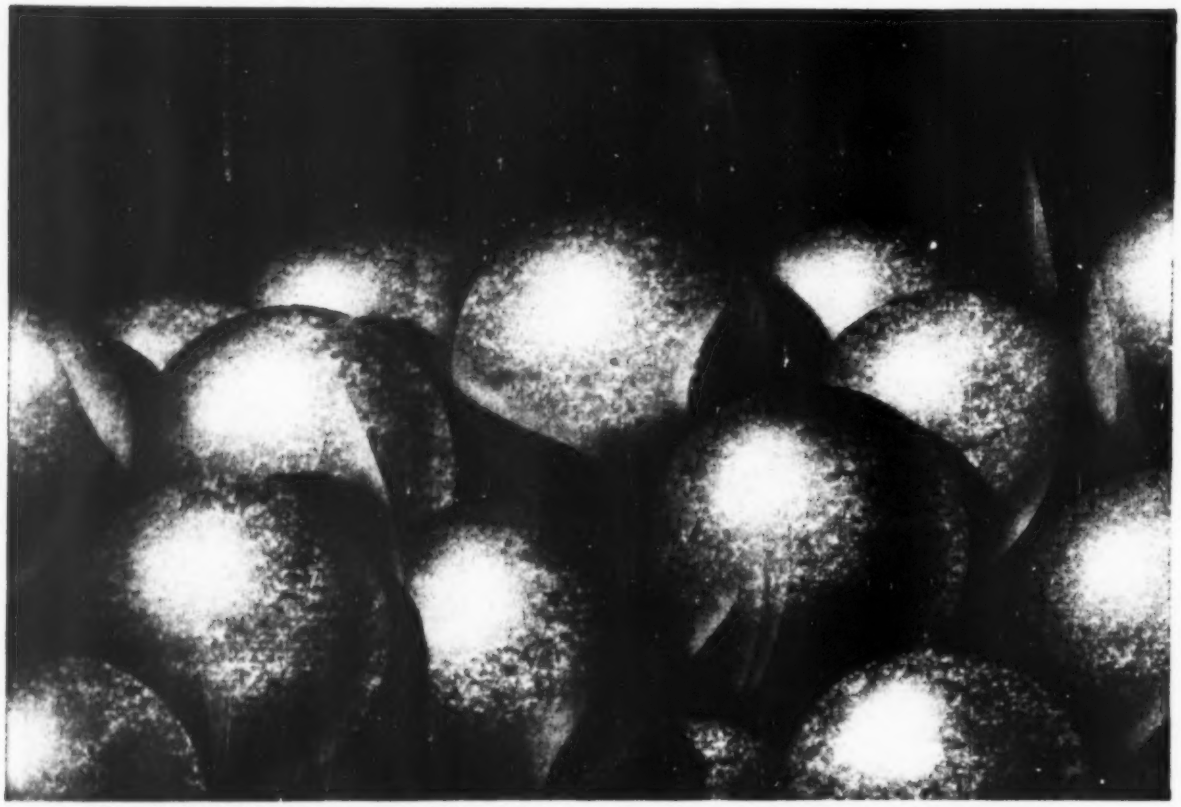
NAME_____

COMPANY_____

ADDRESS_____

CITY_____ STATE_____

Pet. Ref.



Spheres "Bed" Perfectly in catalytic processing. In Norton Spherical Catalyst Supports you get uniform beds that promote uniform flow of gases and assure minimum pressure drop. Spheres are available in sizes ¼" to 1". Supports in Ring and Pellet form in sizes 3/32" to 1".

Catalyst supports to your special prescription

... Norton engineered for your special requirements

Where catalyst supports were applicable Norton engineers have been successful in meeting the requirements of a large variety of conditions.

Over 40 years' experience in research and developments of special refractory materials and mixtures have enabled Norton to tailor special refractory mixtures to meet the requirements of the chemical industry.

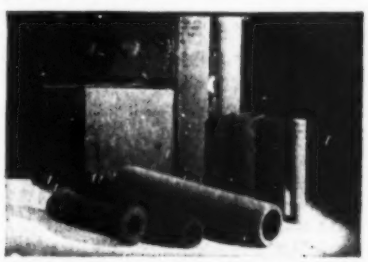
ALUNDUM* Catalyst Supports are a good example. They have such qualities as great refractoriness, chemical inertness, strength and high resistance to abrasive action. They are made by Norton's exclusive "controlled structure" process. It provides medium porosity of 30-35% with rough open structure for maximum adherence of catalyst, or high porosity 42-47% with large connected internal pores, uniformly dispersed for maximum deposition of the catalyst.

Test them yourself

See what Norton ALUNDUM Catalyst supports can do for you. If you would like to see samples, see your Norton refractories representative or write Norton Company, 461 New Bond Street, Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto, Ontario.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

Norton Exclusive Fused Stabilized Zirconia, an amazing material able to take temperatures double the melting point of most metals. No other refractory is so chemically stable at such high temperatures. (Up to 4700° F.) Ask for Bulletin 793.



Norton Exclusive. Norton ALUNDUM *Seamless* Tubes for filtration, aeration, diffusion maintain constant air or liquid pressure. ALUNDUM porous mediums also available in plates, discs and diaphragms. Ask for Bulletin No. 140.

NORTON

REFRACTORIES

ENGINEERED Rx PRESCRIBED

Making better products... to make other products better

NORTON COMPANY, WORCESTER 6, MASSACHUSETTS

From start to start-up

FLUOR HANDLES ALL PHASES OF A PROCESSING PROJECT

Fluor has played a significant role in the development of processes for the petroleum, natural gas, petrochemical and chemical industries. In the design and construction of process plants, Fluor handles the entire job or any part of it. Some of the processes which Fluor is qualified to build include fluid coking, platforming, catforming, fluid and thermofor catalytic cracking, crude distillation, gasoline plants, acetylene and ethylene from hydrocarbons, gas treating, ammonia synthesis, ethylene oxide, ethylene glycol, vinyl chloride, polyvinyl chloride, sulfur from H_2S, desulfurization and many others. For processing facilities, contact Fluor. One organization, one contract.

BE SURE WITH **FLUOR**

THE FLUOR CORPORATION, LTD.
LOS ANGELES 22, CALIFORNIA

FOREIGN: FLUOR OF CANADA, TORONTO
FLUOR INTERNATIONAL, BEIRUT
FLUOR PERUANA, S.A., LIMA
HEAD WRIGHTSON, LONDON

NEW YORK
CHICAGO
PHILADELPHIA
BOSTON
PITTSBURGH
SAN FRANCISCO
HOUSTON
BIRMINGHAM
TULSA

CUPRO NICKEL, 30%-702

for your toughest heat exchange problems

CUPRO NICKEL, 30%-702, is the best and most widely used copper alloy for tubes in refinery heat exchangers operating under the severest conditions—where corrosive materials and cooling waters must be handled at relatively high temperatures and pressures.

In refinery heat exchanger equipment, tubes of Cupro-Nickel, 30%-702, retain strength at relatively high operating temperatures and are resistant to stress-corrosion cracking. The alloy has the property of forming protective films of corrosion products, making it particularly desirable for service where sea water, even at relatively high velocities, is used for cooling.

Our Technical Department will welcome the opportunity to investigate your heat exchanger tube problem and to draw upon its long experience in tube performance to suggest the most suitable alloy. Feel free to use this service.

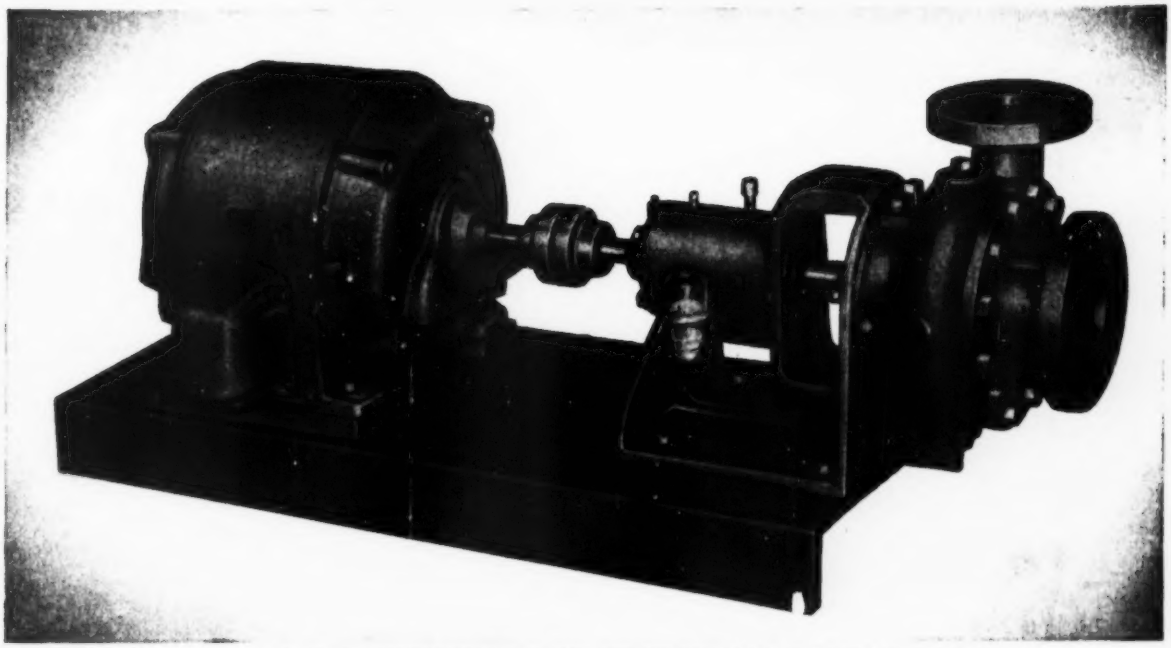
Meanwhile, send for your free copy of Publication B-2, "Anaconda Tubes and Plates for Condensers and Heat Exchangers." *The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.*

53114 Rev.

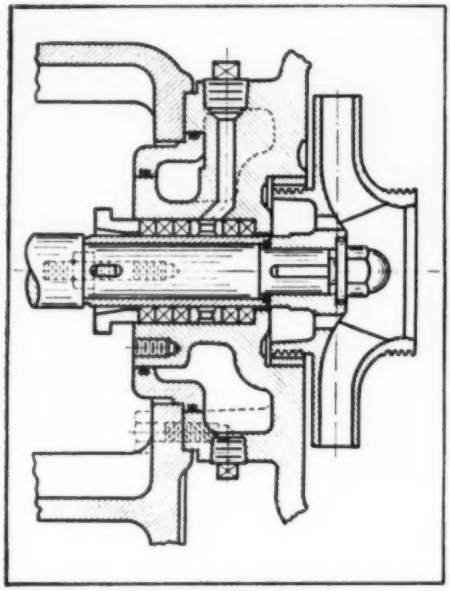
for efficient heat transfer

ANACONDA®

HEAT EXCHANGER TUBES



THE NEW WORTHINGTON TYPE CNR CENTRIFUGAL PUMP is designed to give dependable, trouble-free performance on a wide variety of refinery jobs.



WATER-COOLED STUFFING BOX provides longer life for packing and bearings. Cross-sectional view shows water-jacketing.

Here's another Worthington pump that makes refinery operations more efficient

It's our compact, single-stage Type CNR centrifugal pump, built to handle such refinery jobs as treating, blending, loading and transfer.

Here are some of the features of the modern CNR centrifugals:

1. HEAVY CASINGS in iron or steel for extra wear under high pressure and corrosive conditions.
2. WATER-COOLED STUFFING BOXES with conventional packing or mechanical seals optional.
3. HEAVY-DUTY CONSTRUCTION with 250-pound ASA flanges (150-pound in steel) for really rugged service.
4. INTERCHANGEABILITY. The CNR is part of our SESC pump line. That means complete interchangeability of any pump component for easier servicing, broader range of pump selection and greater availability.

You can get the new CNR's in capacities up to 2700 gpm, to handle temperatures up to 350° F.

Write for Bulletin W341-B16 to Worthington Corporation, Centrifugal Pump Division, Harrison, New Jersey. C.3.9

Types HR and HB. Twenty sizes. Capacities up to 1,800 gpm. Developed heads up to 500 ft. Proper selection of material permits use for temperatures far below zero to 800 F. for pressures from high vacuum to 750 psig.

Type HD. Hydraulically-balanced double-suction impeller handles boiling liquids with low submergence. Capacities range from 600 to 3,200 gpm at heads up to 700 ft. To 850 F and 550 psig.

Type CNE. For loading or transfer service. Capacities to 2,700 gpm. Heads to 500 ft.

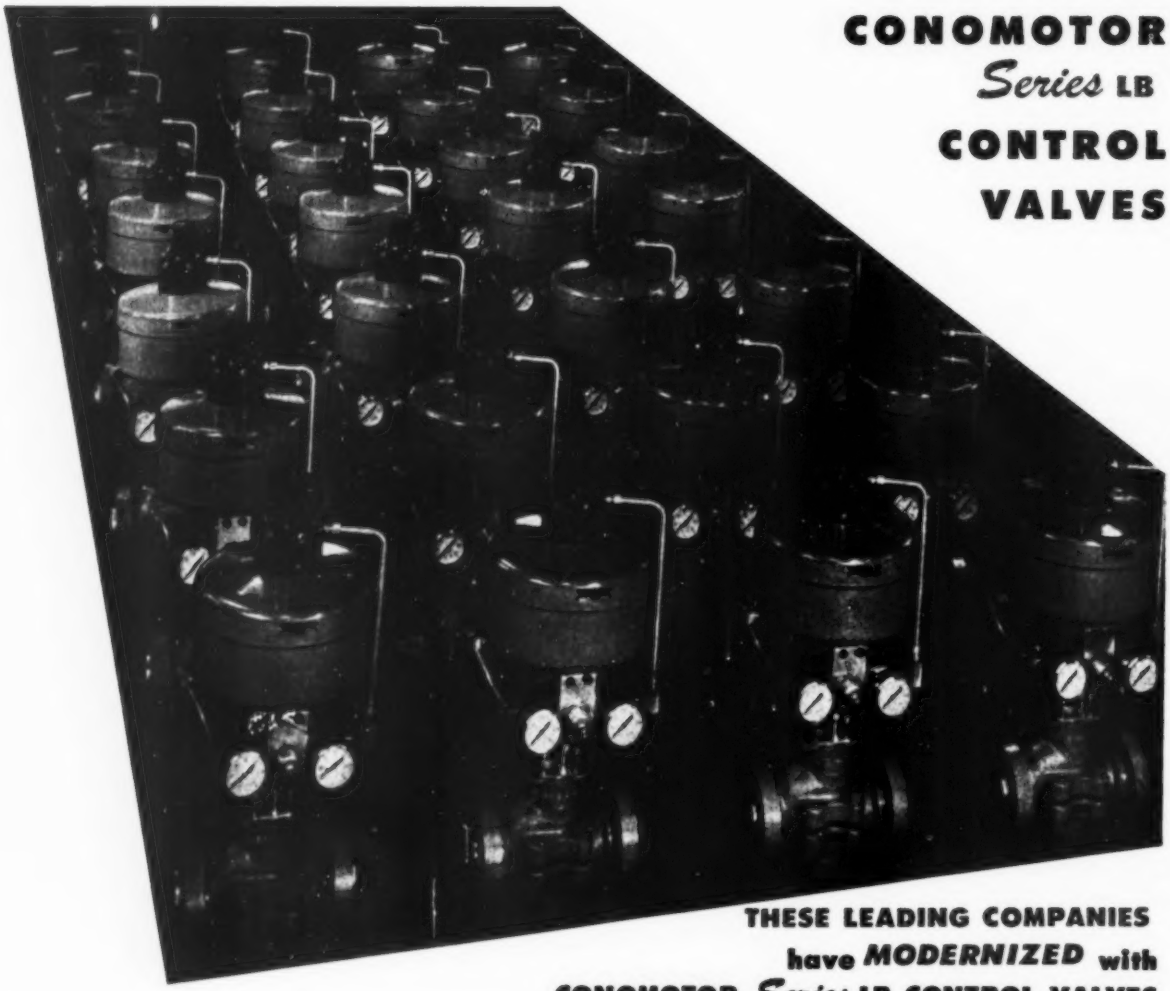
Type HM. Available in 12 sizes. Capacities to 700 gpm. Heads to 475 ft. Up to 500 F.

WORTHINGTON

Centrifugal Pumps

The World's Broadest Line Assures You the Right Pump for Every Job

CONOMOTOR *Series* LB CONTROL VALVES



THESE LEADING COMPANIES have *MODERNIZED* with CONOMOTOR *Series* LB CONTROL VALVES

Progress cannot be denied! Naugatuck Chemical Division of U. S. Rubber Company has completely equipped a new plant with Conomotor Series LB Control Valves for temperature control on reactors. U. S. Steel is using a large quantity of these valves for various services in their new coal chemical facilities in the midwest. E. I. du Pont use Conomotor Control Valves for their complete valve equipment in a new pilot plant at their Eastern Regional Laboratories. Armstrong Cork Co. has standardized on Conomotor LB Valves for an extensive modernization program. These important decisions were based on thorough evaluation of design, performance and cost. When companies of this caliber approve and adopt a new advance in process control, you can rely on their judgment. These and other new installations are typical of the important part Conoflow final control elements play in the modern industrial evolution to automatic control. Whether you have a new plant or plan to modernize your old plant it will pay you to talk to Conoflow.

- Armstrong Cork Co.
- Bakelite Company
- Colgate-Palmolive Co.
- Curtiss-Wright Corp.
- E. I. du Pont de Nemours & Co., Inc.
- Emery Industries, Inc.
- General Electric Co.
- Heyden Chemical Corp.
- Naugatuck Chemical Division U. S. Rubber Co.
- Philadelphia Electric Co.
- Publicker Industries, Inc.
- Jos. Schlitz Brewing Co.
- Sharples Corp.
- The Sherwin-Williams Co.
- U. S. Steel Corp.
- Victor Chemical Works
- Westinghouse Electric Corp.

WRITE FOR CATALOG LB-1, "PORTENT OF THINGS TO COME"

CC-400

Conoflow

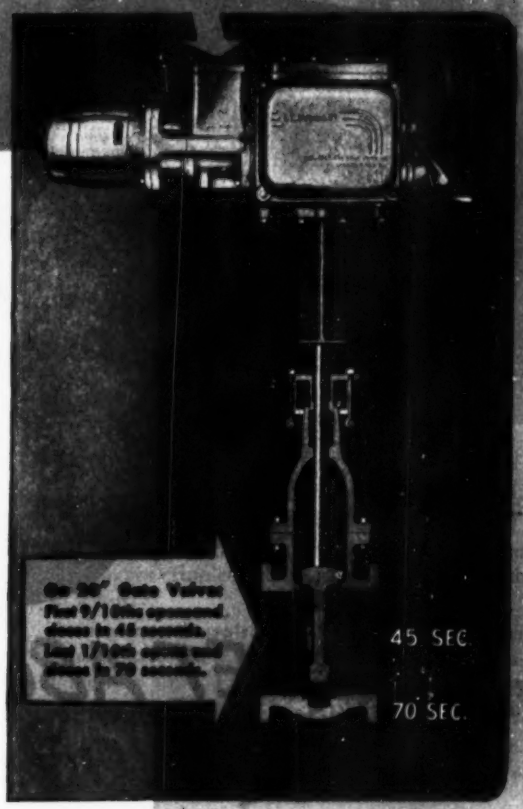
CONOFLOW CORPORATION

FOREMOST MANUFACTURERS OF FINAL CONTROL ELEMENTS

2100 ARCH STREET, PHILADELPHIA 3, PA.

HI-LO LIMITORQUE.

2 SPEED AUTOMATIC VALVE OPERATOR



..helps to prevent SURGE or HAMMER during closure of valves..

The name *Limitorque* has been for years synonymous with dependable MOTORIZED VALVE OPERATION in Refineries, Pipe Lines, Power Plants, Water and Sewage Works . . . throughout the World.

Now, a device is available for use with *Limitorque* which permits a valve to be *operated at 2 different speeds*. This device, known as the "HI-LO" attachment permits the speed of the valve stem to be VARIED AT ANY PRE-DETERMINED POINT . . . or if required, the valve may be opened at one fixed speed and closed at another pre-determined speed.

"HI-LO" is a device which prevents:

- DAMAGE to valves and station pumps.
- BREAKS in pipeline caused by "surge".
- DAMAGE to expensive equipment.
- INJURIES to personnel.

"HI-LO" is a device which minimizes or completely eliminates:

- LINE "SURGE" OR "HAMMER" during closure.
- NECESSITY OF BY-PASS VALVES because of greatly increased torque during initial valve opening.
- ELEMENT OF HUMAN ERROR, to a great extent, in operation.

The 2-Speed "HI-LO" is new, different, exclusive, and when combined with *Limitorque*, gives simple, positive, automatic and safe motorized valve operation.

Above illustration shows a 20" Gate Valve with first 9/10ths of travel closed in 45 seconds—and last 1/10th of travel to close in 70 seconds. However, change from high to low speed can be made at any pre-determined point of travel. Operation can also be fixed to obtain one speed closing, and one speed (either faster or slower) in opening of valve.

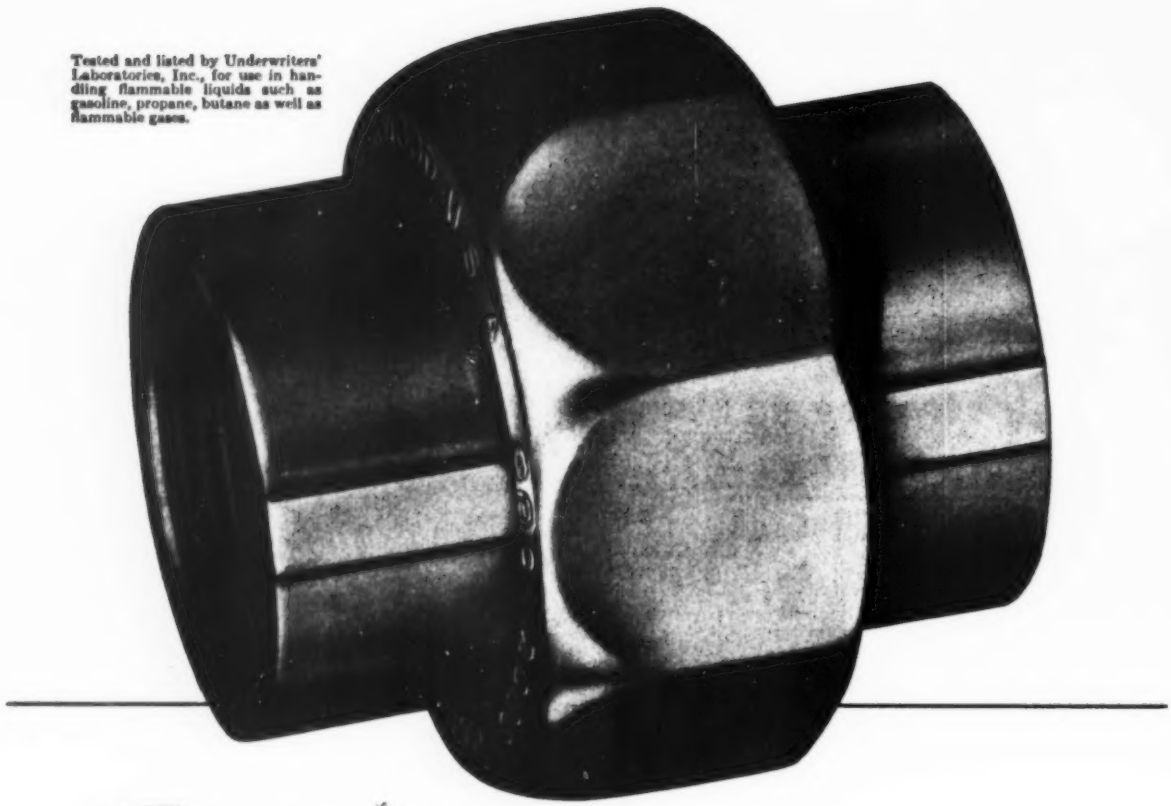
Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

Tested and listed by Underwriters' Laboratories, Inc., for use in handling flammable liquids such as gasoline, propane, butane as well as flammable gases.



FORGET ABOUT CORROSION!

Rockwood Union seats are made of stainless steel or Moly 431 ... thanks to cold-forging

Yes. Rockwood cold-forged steel Unions are corrosion-proof. No more worries about corrosion at seat joint.

And that's not all —

The non-corrosive seats are double-locked in place, under 100,000 and 400,000 lb. pressure. They can't work loose because they're an integral part of the Union. And their plug type ball-to-cone design has no sharp corners or knife-like edges. Piping misalignment is done away with.

The new, over-all balanced design of Rockwood Unions gives all three parts equal strength. You get higher resistance to tough working conditions — expansion and construction-shock — jar and vibration. Absolute interchangeability of parts for speedy replacement.

All Rockwood Unions are "Rockwoodized" against corrosion — a special coating process. For details on the complete line, write Rockwood Sprinkler Company, 102 Harlow Street, Worcester 5, Mass.

Special Non-Corrosive Seat Construction gives Rockwood Unions superiority. Specify Rockwood Type 602 Union with two Stainless Steel seats — or Rockwood Type 603 Union with two Moly 431 seats.

ROCKWOOD

SPRINKLER COMPANY

MANUFACTURERS OF THE MOST COMPLETE LINE OF STEEL UNIONS ON THE MARKET

WORCESTER 5, MASSACHUSETTS

First Aid for

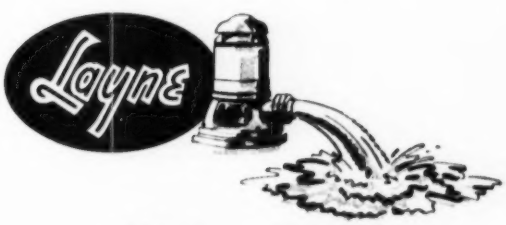
CRIPPLED WATER SYSTEMS

■ Are your water pumps past their prime? Wells showing signs of internal disorders? Better call in Layne for a checkup. Layne water supply specialists can get crippled water systems off their crutches in a hurry.

Emergency Repairs—Layne has the equipment, repair parts and skill to make emergency repairs in minimum time. Field crews are qualified to pull and repair all makes of vertical turbine pumps.

Water Well Acidizing This often adds years to the life of failing water wells. It may be the answer to your water supply problem.

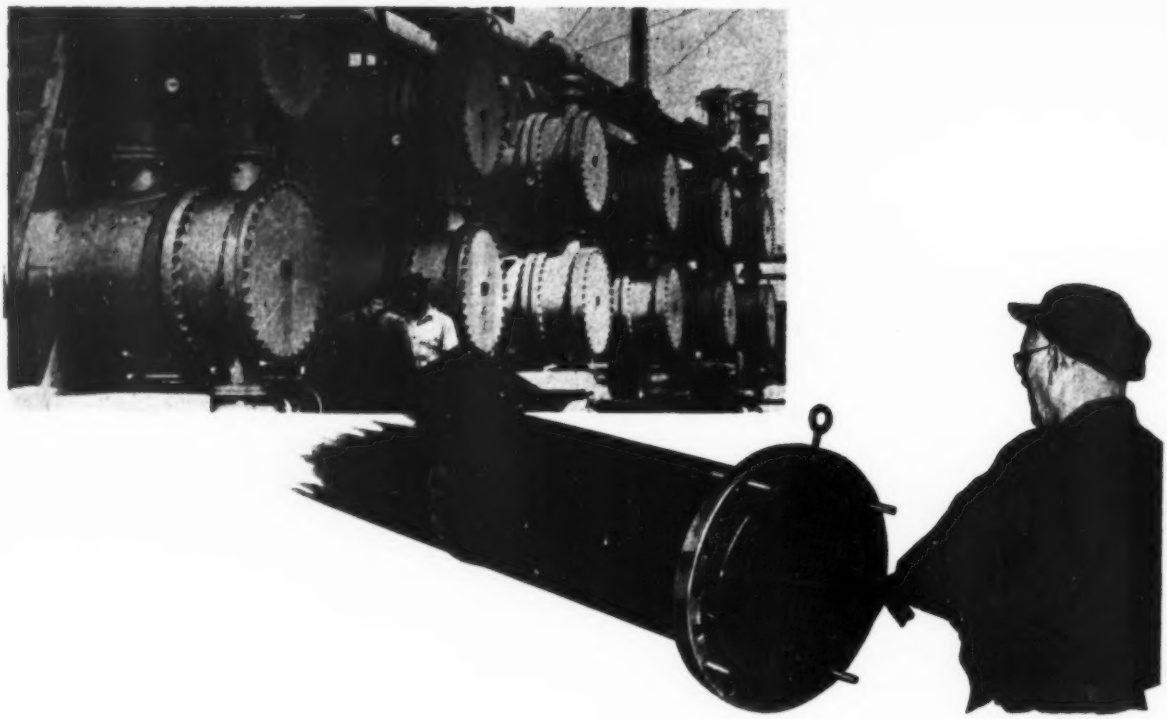
Layne repair and maintenance service, backed by 72 years of experience, keeps water supplies up and costs down. Get complete details now from your nearest Layne Associate Company. Or write Layne & Bowler, Inc., Memphis 8, Tenn.



Water Wells
Vertical Turbine Pumps

WATER TREATMENT

Layne Associate Companies Throughout The World



When it's time to Retube use uniform ELECTRUNITE Heat Exchanger Tubes

Switching to Republic ELECTRUNITE Pressure Tubes can solve a lot of heat exchanger problems. And one of the big reasons is uniformity.

These tubes are uniformly round. And because wall thickness is uniform, inside and outside diameter are concentric. Physical properties are uniform, too. This kind of quality control is possible because Republic makes its own steel from ore to finished product. And it is this same steel that goes into ELECTRUNITE Pressure Tubes.

The results: Tubes slide in quickly. They expand easily with less danger of over or under-rolling. And because they are fully normalized, uniformly ductile, ELECTRUNITE Pressure Tubes roll-in and bead fast . . . make tight joints . . . save time.

On your next job . . . tubing or re-tubing . . . boiler, condenser or heat exchanger . . . it will pay you to specify ELECTRUNITE Pressure Tubes. Available in carbon or Enduro Stainless Steel analyses. Write for Bulletin CEC-54.

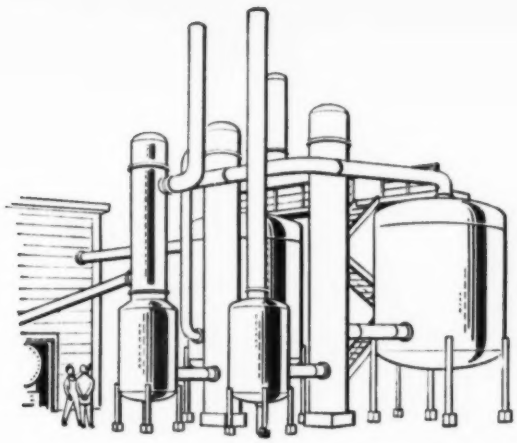
REPUBLIC STEEL CORPORATION
Steel and Tubes Division
220 East 131st Street, Cleveland 8, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, New York

Write For "BOOKLET SPI-54" which gives useful data and specifications on Republic ELECTRUNITE Pressure Tubes, both carbon and stainless.

REPUBLIC STEEL

ELECTRUNITE

ELECTRUNITE . . . THE ORIGINAL ELECTRIC WELDED BOILER TUBE



DON'T BURN PROFITS!

Extra profits from your refinery or natural gas operation are going up in smoke if you aren't producing sulphur from your waste hydrogen sulphide. With a Pritchard-built sulphur recovery plant, you can eliminate air pollution and economically convert that dangerous liability into a highly profitable asset—elemental sulphur.

Pritchard has been appointed by Stanolind Oil and Gas Company as a licensing agent for new patented processes, practical design data and operating specifications to provide efficient sulphur recovery.

Write today for information on how a Pritchard-built sulphur recovery plant can eliminate air pollution and produce extra profits for you.

Industry's Partner for Progress

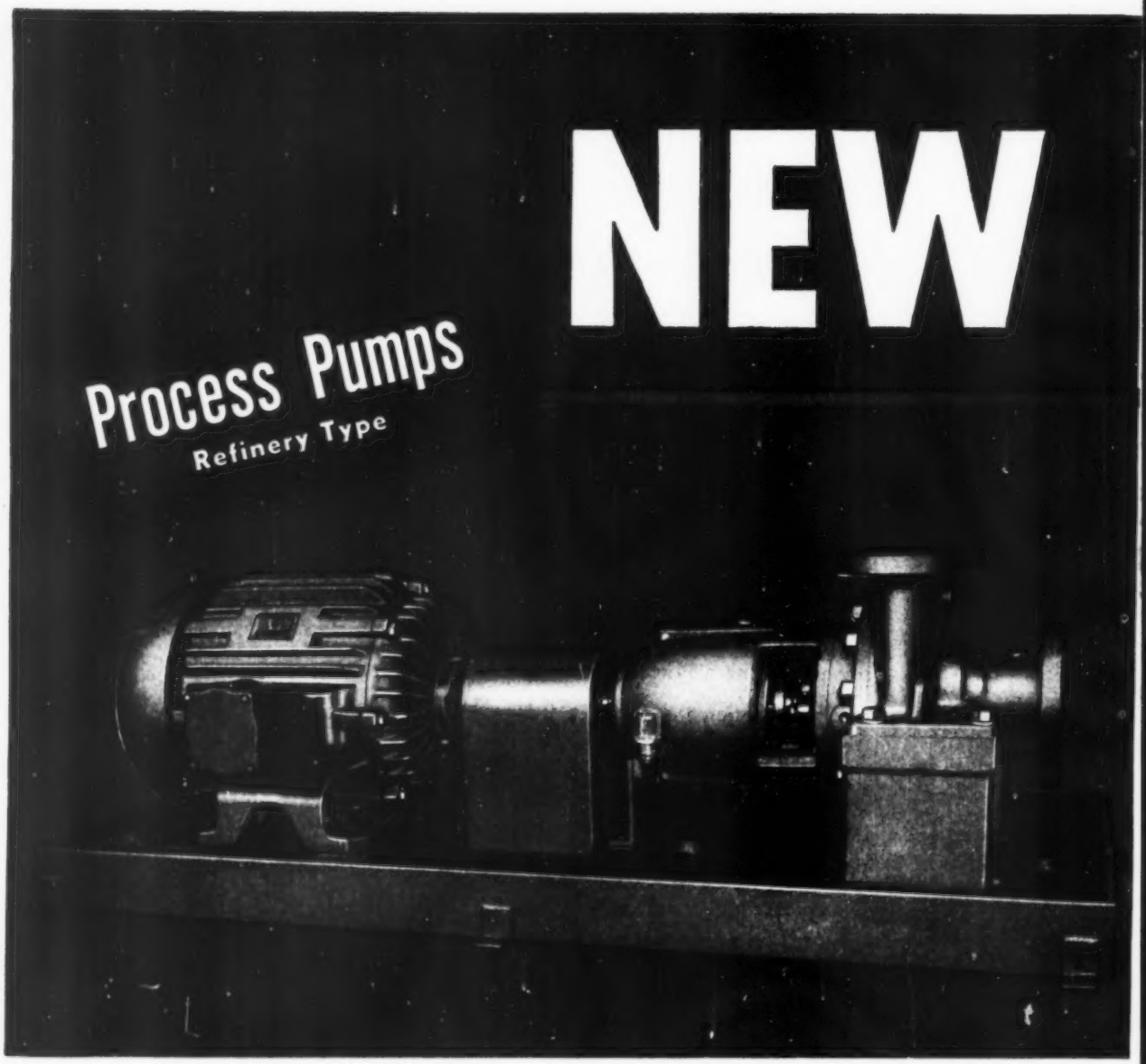
Serving the Gas, Power, Petroleum and Chemical Industries

J.F. Pritchard & Co.

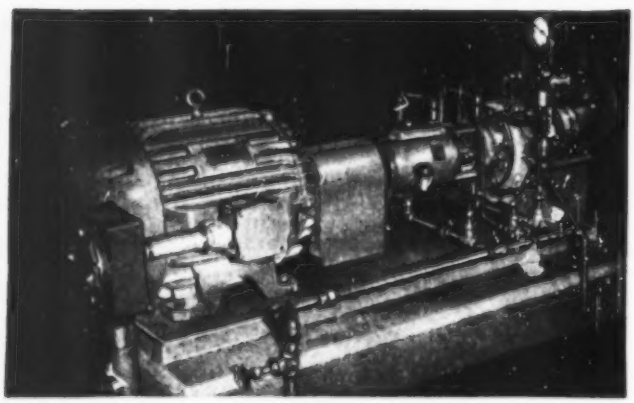
ENGINEERS • CONSTRUCTORS • MANUFACTURERS

Dept. 317, 210 West 10th Street, Kansas City 5, Mo.

CHICAGO • HOUSTON • NEW ORLEANS • NEW YORK
PITTSBURGH • ST. LOUIS • TULSA



Easy Installation and Maintenance



All Allis-Chalmers Type R pumps are furnished with spacer-type couplings. This type of coupling permits the pump to be disconnected from the driver and the entire rotating element — bearing bracket, shaft and impeller — removed without disturbing either the piping or the driver. This type of assembly permits quick examination of the pump, simplifies repairs or replacements and keeps downtime of the unit to a minimum.

In addition, two sets of bearing bracket assemblies fit the complete range of pump sizes. Since parts for only two sizes of bearing brackets are required, regardless of the number of pumps operated, parts inventories are greatly reduced. All bearing bracket parts of R-9 pumps are interchangeable and all R-12s are interchangeable. Where continuous operation is vital, a complete spare assembly can be kept on hand and replaced very quickly.

Refinery Pump

☆ Specially designed for high temperature operation

☆ Choice of materials and stuffing box arrangements

☆ Ample provision for cooling

HERE IS AN ENTIRELY NEW refinery-type pump. It has every feature designed for continuous trouble-free service and to keep your process pumping costs low.

Sealing Arrangement

When the standard stuffing box is used, it carries an adequate amount of packing plus a seal cage. A mechanical seal is interchangeable with the packing. No machining required. A seal plus auxiliary stuffing box may be installed by simply cutting off the end of the standard stuffing box.

Cooling Methods

The stuffing box is cooled by a water jacket of ample capacity. Further cooling of the packing is provided by in-and-out connections for the sealing oil, which is thus able to act as a coolant as well as a sealing medium. The stuffing box is provided with a water-flushed smothering gland. A second water jacket surrounds the front bearing and the lower part of the oil reservoir. For extremely high temperature operation, a water-cooled pedestal can be supplied.

Throat Bushing

A renewable throat bushing is tack-welded on the pump side of the stuffing box. The close clearance between the bushing and the shaft sleeve cuts infiltration into the stuffing box to a minimum. In case of seal or packing failure, the bushing remains in position and will not blow out.

Wearing Rings

The impeller and casing are both provided with front and rear wearing rings which make it easy and economical to maintain proper clearance. This design also reduces side thrust which in turn reduces shaft deflection and wear.

Double Volute

Double volute design is used in pumps of more than 400 gpm capacity. Forces set up in one volute are counteracted by equal and opposite forces in the other volute. Deflection forces are greatly reduced.

The impeller has low NPSH requirement so that it will successfully handle high volatile liquids at high temperatures.

Centerline Mounting

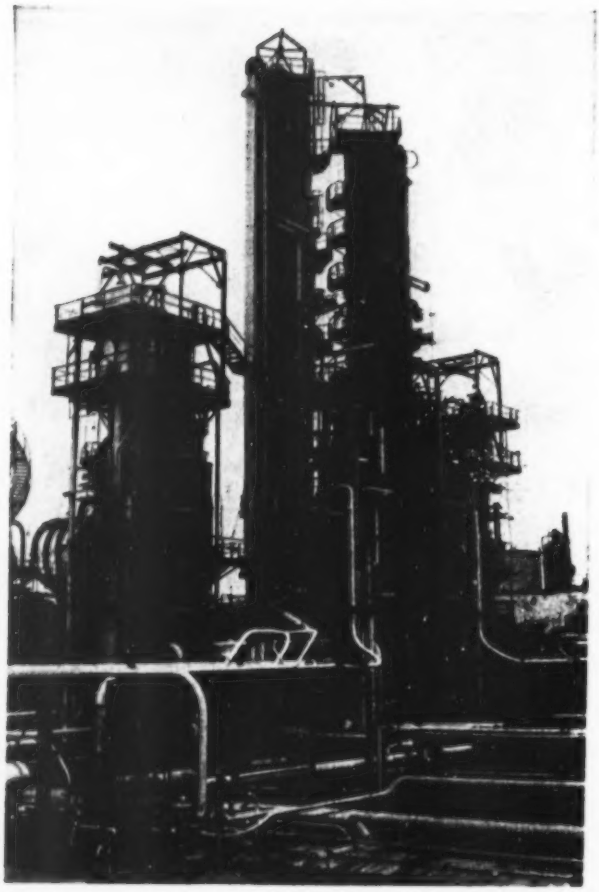
The pump is mounted at the centerline of the casing. Pipe strains are transmitted directly to the foundation. When proper precautions are taken, alignment of rotating parts will not be affected.

Complete Pumping Unit

Allis-Chalmers can supply a complete pumping unit — pump, motor and control — assembled and ready to install. Coordinated design and manufacture assure undivided responsibility. Call your nearby Allis-Chalmers District Office for help on your next pumping problem. Or write for Bulletin 52B7775. Allis-Chalmers, Milwaukee 1, Wis.

A-4031

ALLIS-CHALMERS



New Crude Distillation Towers at SOHIO's Cleveland No. 1 Refinery. These twin 3-stage units are 130 feet high, 13 feet O.D.; handle 22,500 bbl. per day each. Monel linings limit corrosion in upper sections. Fabrication by A. O. Smith Corp. Engineers and contractors, Arthur G. McKee & Company.

Why Sohio put Monel on Top..

when they picked materials to limit corrosion in new atmospheric towers

Slugs of crude get shunted around the country today, as if they were tank cars.

With so much crude moving in "common-carrier" pipelines...there's no telling from one day to the next what composition you may be called upon to refine.

SOHIO's Cleveland Number 1 Refinery draws its crudes, for example, from the Mid-Valley and Buckeye Lines . . . and taps output of wells in Arkansas, Illinois, Mississippi, Oklahoma, Texas and Louisiana. Most of the time sulfur content is under 1½%. Sometimes it goes much higher. Salt content, too, is unpredictable.

That's why SOHIO engineers went all out to limit corrosion in two new 130-ft. atmospheric towers for crude distillation. They lined the bottom 50 feet with Type 405 (12% Cr) to resist hot sulfide corrosion. In the middle sections, where naphthenic acids are likely, they put nickel-bearing Type 316 ELC stainless*.

For the top 40 feet, they chose Monel®. In this location they have found Monel to be the most economical material for the job.

There are several reasons for this. For one thing, Monel costs less per pound than other alloys able to withstand the corrosion. Furthermore, it requires no heat-treatment after fabrication to restore corrosion resistance, since its corrosion resistance is not impaired by welding. Then, too, Monel is easy to form . . . and lends itself well to Smithlining.

(Smithlining is the resistance welding process used by the tower fabricators, A.O.Smith Corp., to bond Monel and other liners to carbon steel walls.)

But the most important reason for choosing Monel is the way Monel stands up to the various corrosives found in upper sections of fractionators.

In this area, reflux pushes vapor temperatures down to about 250°F. Walls and trays cool vapors further. As they go below the dew point, aqueous hydrochloric and sulfuric acids form in the condensate. Corrosive salt compounds may be present also.

The record of Monel in resisting *all* these forms of corrosion, when temperatures are under 500°F., is outstanding . . . so outstanding that many companies consider Monel to be the standard construction material for lining top portions of fractionators.

If your next inspection shows corrosion at the tops of your crude distillation towers, why not investigate the use of Monel? A letter addressed to Inco's Corrosion Engineering Section will bring full information regarding the application of Monel in this corrosive service. No cost or obligation, of course.

*Where there is a possibility of naphthenic acid attack, either alone or combined with high temperature sulfur corrosion, *Inconel®* is often a favored material. Since its thermal expansion coefficient (6.4 for the wrought material) is very close to that of mild steel, Inconel lends itself unusually well to lined construction.

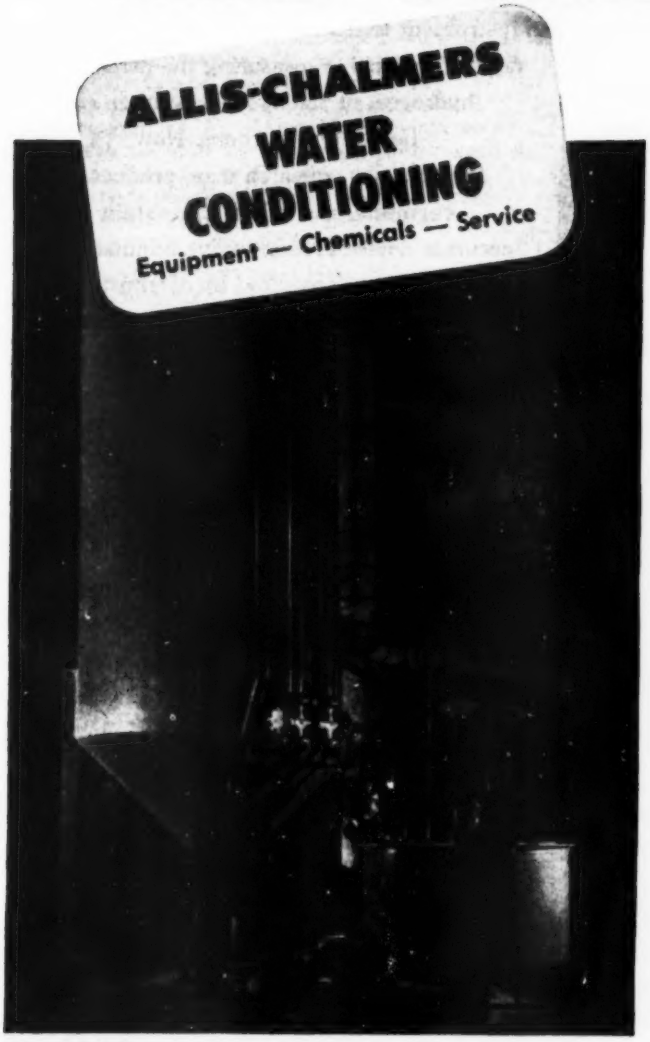
INCO

Monel...*for minimum maintenance*

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

Gilbert Paper Co., Menasha, Wis.

Prevents SCALE and CORROSION



Equipment at Gilbert Paper Company includes hot process lime-soda softener and chemical feeder. For more information on this process, write for Bulletin 2886611.

To prevent scale and corrosion in water used for steam generation, Gilbert Paper Company removes mineral constituents and dissolved gases by using Allis-Chalmers hot process lime-soda water conditioning. As a result, boiler outages and maintenance are greatly reduced. The process is the same as that used in many installations for process water.

What Hot Process Lime-Soda System Does

The complete installation heats water to the boiling point for removal of corrosive gases. Proportioning equipment introduces chemical reagents continuously and precisely into the water being treated. Precipitate induced by the thermo-chemical reaction is coagulated, settled, and separated from the water, which is then ready for use in steam generation. Apparatus includes a chemical solution tank, chemical proportioner and pump, reaction and sedimentation tank, pressure filters and accessories.

How You Can Solve Your Water Problems

If you have a water problem, you'll find Allis-Chalmers complete service a useful addition to your power or process water operations. Many years of experience plus a complete line of equipment and chemicals enable Allis-Chalmers water conditioning experts to recommend sound, economical solutions to your problems. For help with your water conditioning, call the Allis-Chalmers district office nearest you or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4190

ALLIS-CHALMERS

From Atomic Research

COMES FASTER... MORE ACCURATE

measurement of percentage hydrogen in liquid hydrocarbons . . . . . .

Here is an instrument that utilizes the absorption of beta rays as a means of measuring the percentage of hydrogen, or the hydrogen-carbon ratio, in liquid hydrocarbons. Now . . . for the first time . . . research men, product control engineers, and others can obtain a quick, accurate determination in five minutes instead of the four hours required by combustion train methods. Furthermore the measurement is made with an accuracy of 0.02 weight percent hydrogen as compared with the usual 0.05 weight percent hydrogen.

The new Cenco Beta Ray H/C Meter has numerous applications in petroleum processing . . . in refining operations where the hydrogen-carbon ratio is altered . . . where the percentage of hydrogen is an index to the performance of end products, as fuel oils, jet fuels, gasolines, etc. Full details about this modern precision instrument are contained in our Bulletin No. 115. Write for your copy today. Exclusive manufacturing and sales rights for the Cenco Ray H/C Meter have been assigned to Central Scientific Company by Standard Oil Company (Indiana).

The NEW cenco® Beta Ray H/C Meter utilizes radioisotopes

Our 14 branch offices and warehouses assure prompt service and shipment of laboratory apparatus and supplies.

cenco

The most complete line of scientific instruments and laboratory supplies in the world

R.S.C.

CENTRAL SCIENTIFIC COMPANY

MAIN OFFICE — PLANT — CENCO INTERNATIONAL CIA.
1700 IRVING PARK ROAD • CHICAGO 13, ILLINOIS

BRANCHES AND OFFICES — CHICAGO NEWARK BOSTON
WASHINGTON DETROIT SAN FRANCISCO SANTA CLARA LOS ANGELES

CENTRAL SCIENTIFIC CO. OF CANADA, LTD. (and Hendry Division)
TORONTO MONTREAL VANCOUVER OTTAWA

REFINERY SUPPLY COMPANY — TULSA HOUSTON

Packaged Compressor Plant

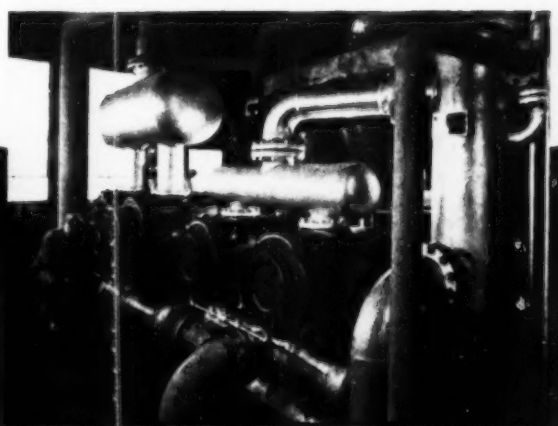
Lowest Cost Per Horsepower Installed

THE PEOPLES NATURAL GAS COMPANY, of Pittsburgh, Pennsylvania, had the problem of obtaining rapid recovery of its native reserve of natural gas from a portion of an underground storage pool near Jeannette, Pa. The area had been taken over by an affiliated company, New York State Natural Gas Corp., for the development of Oakford pool, and it had been agreed that Peoples Natural Gas Co. could produce the remainder of the gas still in place before storage operations became too far advanced. They installed three 550 horsepower Beaird-Ingersoll-Rand packaged compressor plants near Jeannette, Pa. which pump gas out of the original producing formations into distribution lines. Each unit has two stages of compression with interstage scrubbers and interstage gas cooling as well as all necessary manifolds, piping, lubrication and cooling systems. All of these three plants were fully assembled at the Beaird plant on rugged steel bases and shipped as complete units. Their complete packaging reduced installation time at the location and took advantage of lower assembly costs at the factory.

Let us give you the actual facts on lower installation costs of Beaird-Ingersoll-Rand packaged compressor plants.

Three 550 h.p. units —

RECOVER RESERVE FROM UNDERGROUND GAS STORAGE POOL



These three Beaird-Ingersoll-Rand packaged compressor plants are complete with Ingersoll-Rand 550 horsepower 10SVG engine driven compressors, Young radiators and all other necessary components and controls. Made in sizes from 110 h.p. to 550 h.p.

THE J. B. BEAIRD COMPANY, INC.

Shreveport, Louisiana

BEAIRD

MACHINING MANUFACTURING STEEL WAREHOUSE

PACKAGED COMPRESSOR PLANTS

CAST STEEL FITTINGS

PRESSURE BULK STORAGE

ANHYDROUS AMMONIA EQUIPMENT

LP-GAS SYSTEMS

BEAIRD ***Cast Steel Fittings***

Fittings that fit

FITTINGS *IN A HURRY*

Need fittings in a hurry? Want to be sure of meeting your deadlines? Have to meet an emergency with minimum down time? Then ask your supply house . . or call us direct . . for immediate shipment of Beaird fittings from our large stock of standard sizes. Save time in ordering by using the convenient selection charts and figure numbers in our new catalog No. 153. We can also give you prompt delivery on special fittings from our wide assortment of patterns.

Write for Catalog 153 and let us put your name on our mailing list for current stock lists.

THE J. B. BEAIRD COMPANY, INC. *SHREVEPORT, LOUISIANA*

BEAIRD

MACHINING MANUFACTURING STEEL WAREHOUSE

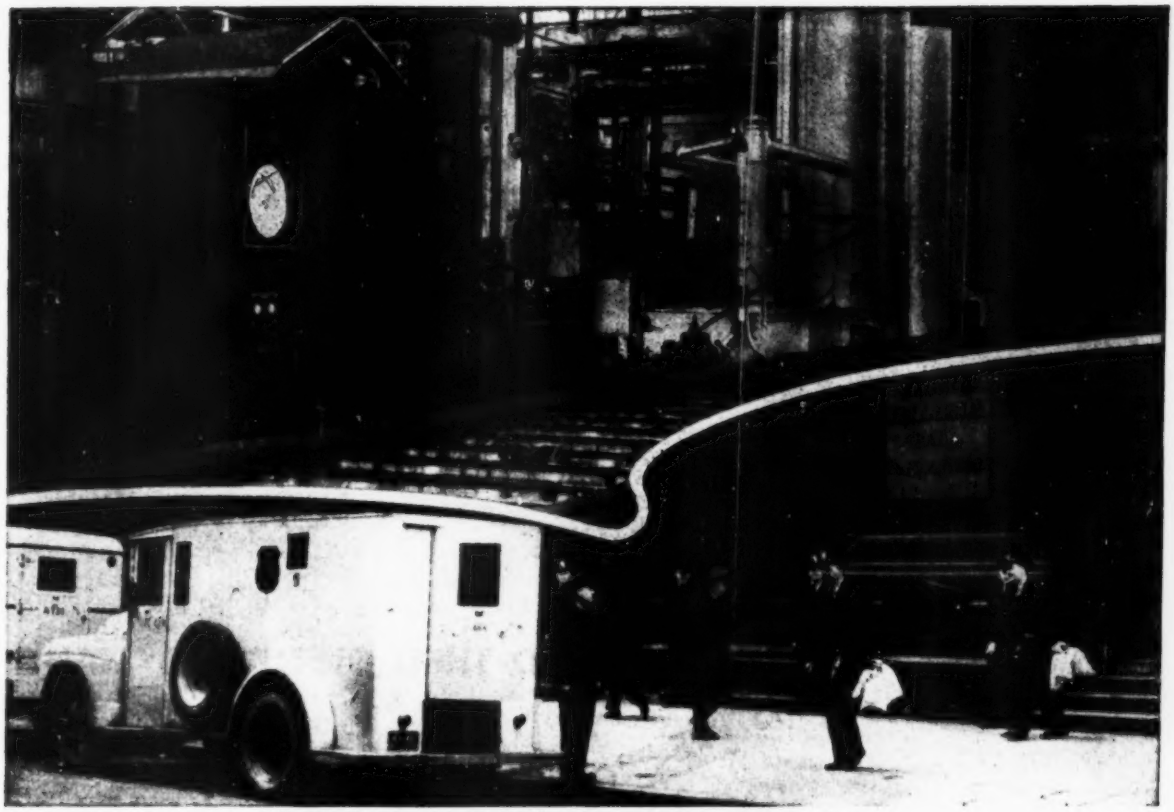
PACKAGED COMPRESSOR PLANTS

CAST STEEL FITTINGS

PRESSURE GAS STORAGE

ANHYDROUS AMMONIA EQUIPMENT

LP GAS SYSTEMS



Modern Safeguards—Brink's for Money, Bailey for Process Materials

Are Your Process Materials Guarded As Well?

HERE'S HOW TO PREVENT SPOILAGE AND WASTE . . .

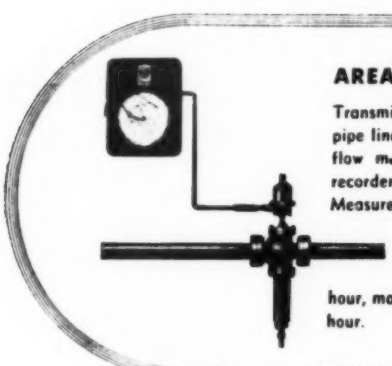
TO avoid waste of valuable process materials and finished products, process rates and conditions must be accurately measured and controlled. That's where Bailey Meters, Analyzers and Controllers can help you to improve the efficiency of your plant.

Take flow for instance. Bailey Meter Company offers a complete line of flow measuring and controlling equipment for applications ranging all the way from high pressure steam to low pressure gas. We measure flow in pipes, open channels, ducts, furnaces, smelters, kilns, ovens, dryers.

When you call Bailey Meter Company, you get the help of years of experience as well as recommendations from a wide selection of measuring and controlling devices.

Your local Bailey Engineer is as near as your telephone. He has the experience and the equipment necessary to set up an effective guard for your process materials.

P-26



AREA TYPE FLOW METER

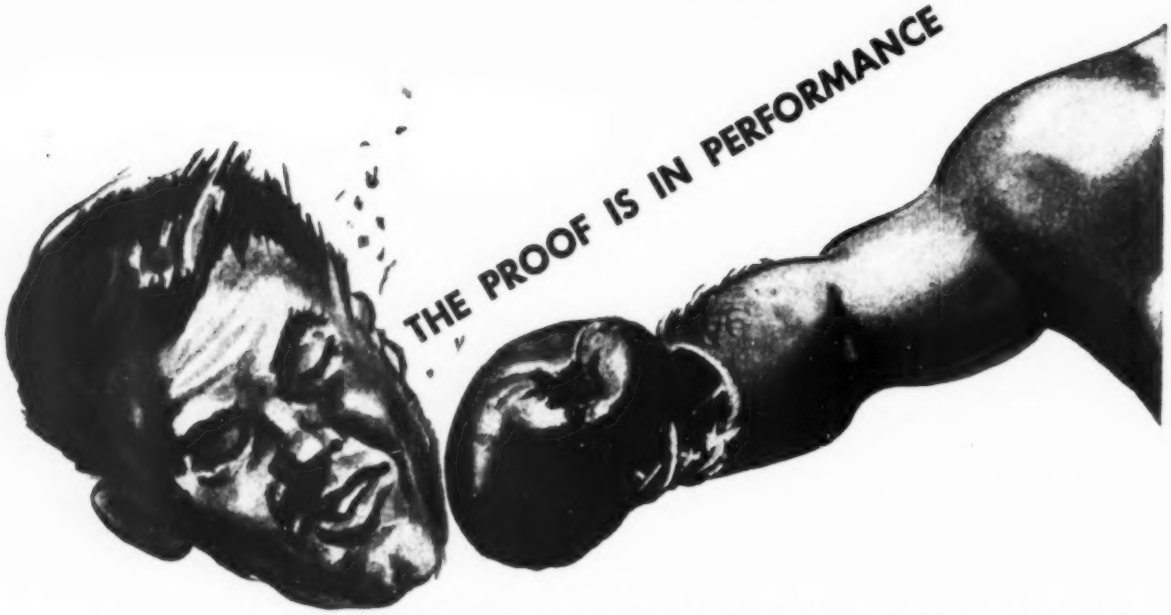
Transmitter goes into 1, 3 or 4 inch pipe line like a valve and transmits flow measurements electrically to recorder in remote location. Measures oil and other clear liquids under static pressures up to 600 psi. Minimum range 0 to 1200 lb per hour, maximum range 96,000 lb per hour.

BAILEY METER COMPANY

1043 IVANHOE ROAD
CLEVELAND 10, OHIO

Process Controls

TEMPERATURE · FLOW
PRESSURE · LEVEL
GAS ANALYSIS · RATIO



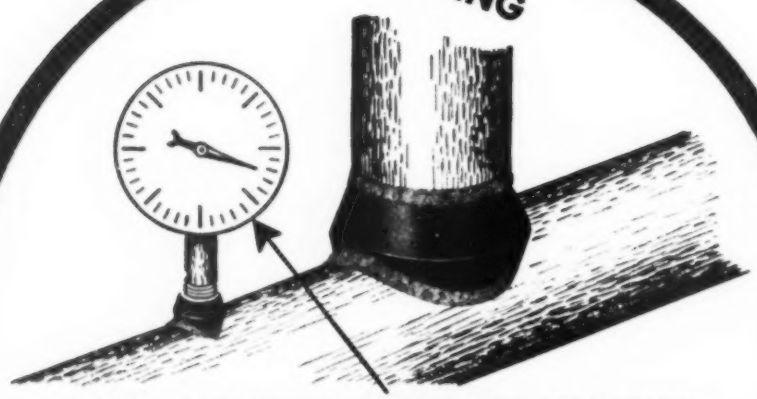
WELDOLET AND THREDOLET PERFORMANCE

IS PRE-PROVED BY TESTING

WeldOlets
Butt-welding

Socket WeldOlets

ThredOlets



SPECIFY AND USE WELDOLETS AND THREDOLETS

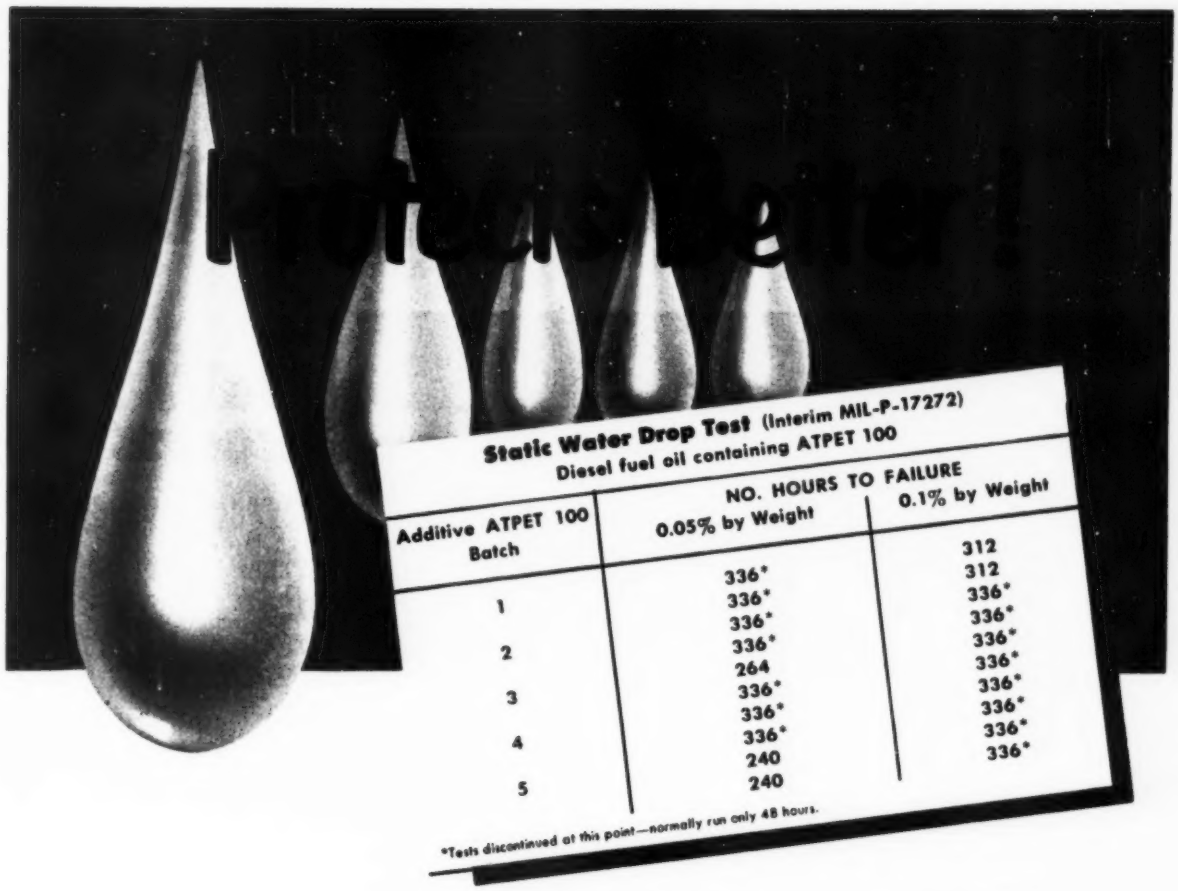
Their predetermined performance standards are your guarantee of permanent piping. WeldOlet and ThredOlet design and performance are backed by Bursting Tests in accordance with A.S.A. B16.9 Code for Welding Fittings.

WELDING FITTINGS DIVISION

BONNEY FORGE & TOOL WORKS

ENGINEERING DEPT. • 721 MEADOW STREET • ALLENTOWN, PENNSYLVANIA

DISTRIBUTORS IN PRINCIPAL CITIES



Static Water Drop Test (Interim MIL-P-17272)
Diesel fuel oil containing ATPET 100

Additive ATPET 100 Batch	NO. HOURS TO FAILURE 0.05% by Weight	0.1% by Weight
1	336*	312
	336*	312
	336*	336*
2	336*	336*
	264	336*
3	336*	336*
	336*	336*
4	336*	336*
	240	336*
5	240	

*Tests discontinued at this point—normally run only 48 hours.

ATPET® 100

non-metallic corrosion inhibitor

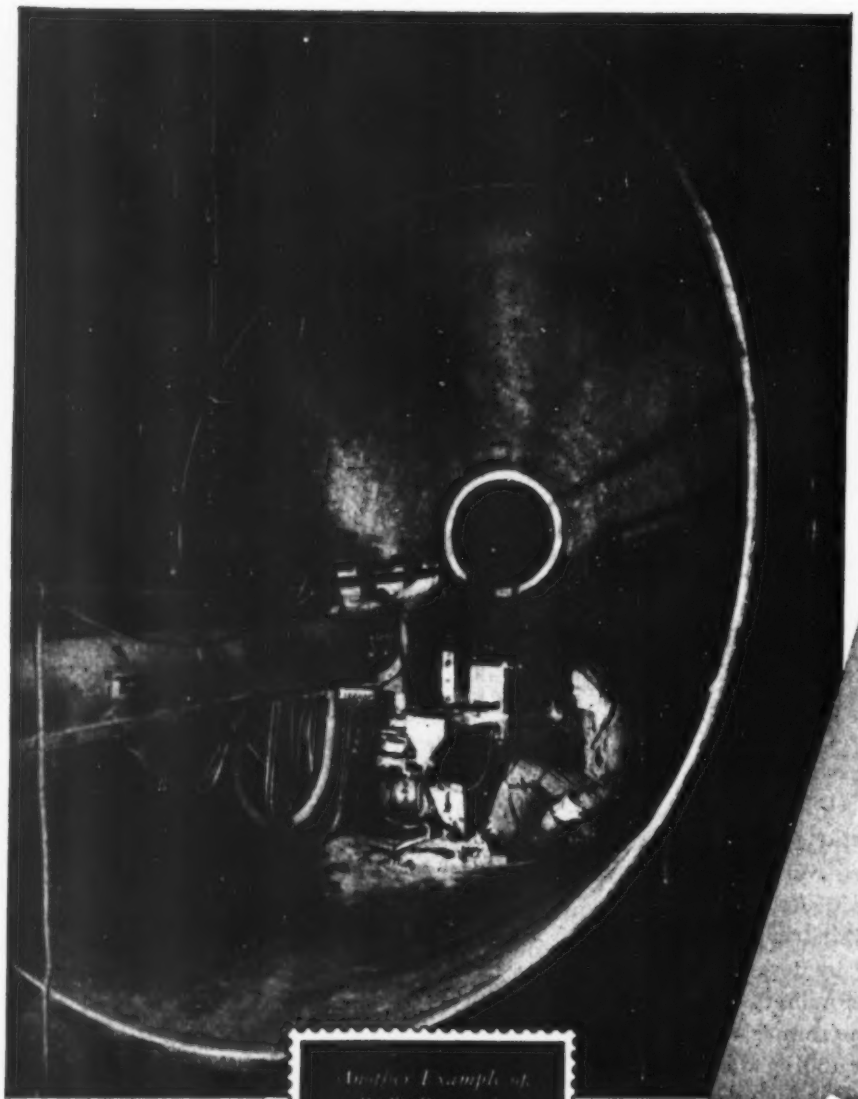
PUT greater anti-rust protection in slushing compounds, #2 fuel oils, engine preservative oils, film type inhibitors, or turbine oils . . . with ATPET 100, the new Atlas non-metallic corrosion inhibitor. Its effectiveness in preventing rust is proved by tests made in our laboratories in accordance with military specifications. In the static water drop test, for example, diesel fuel oils with as little as 0.05% ATPET 100 by weight average more than 300 hours . . . or better than seven times the normal test requirement.

- Completely organic, ATPET 100 leaves no ashy residue. It's always uniform from batch to batch. And it's economical to use . . . priced in the range of metallics.
- Get technical facts and samples by writing or calling Atlas today.

INDUSTRIAL CHEMICALS DEPARTMENT
ATLAS POWDER COMPANY
WILMINGTON 99, DELAWARE
offices in principal cities
ATLAS POWDER COMPANY, CANADA, LTD.
BRANTFORD, CANADA

this Plus Value

in B&W process equipment



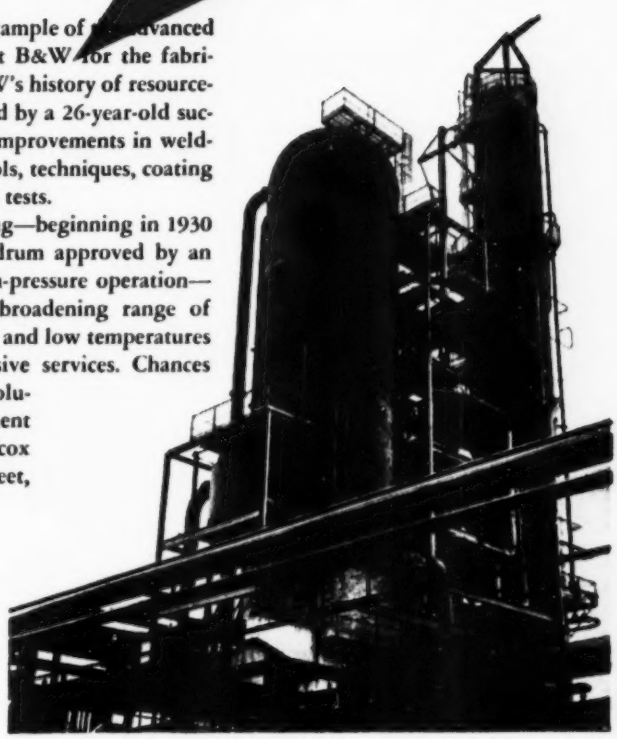
Another Example of B&W Research, Engineering & Facilities

S-4097

PAYS DIVIDENDS HERE

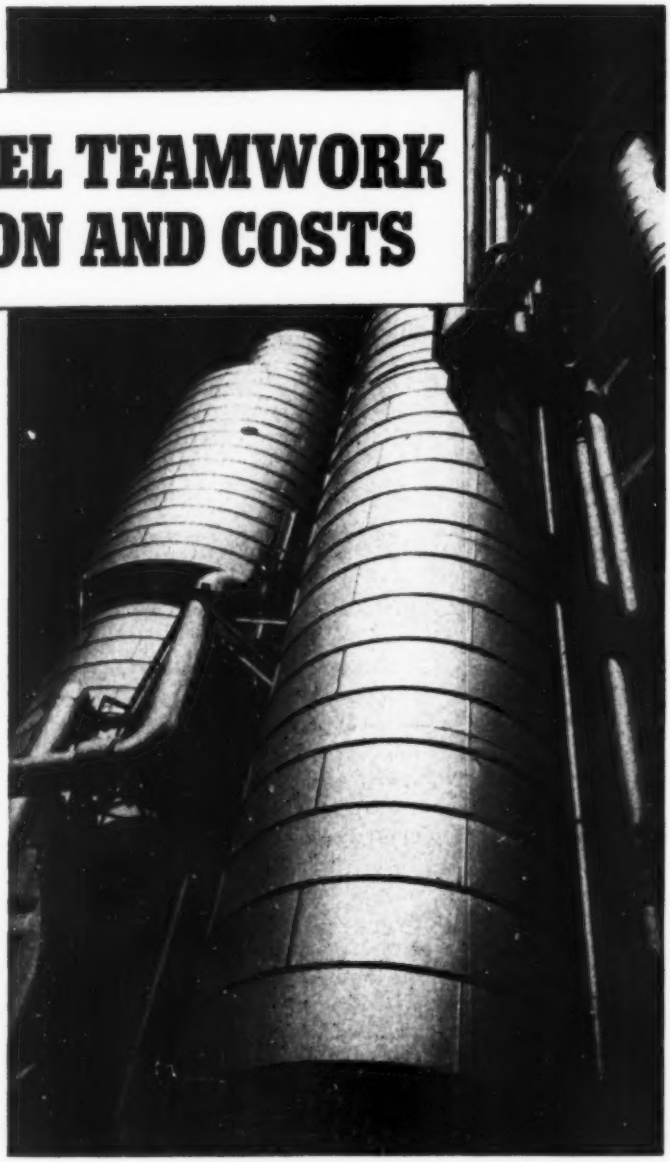
Illustrated at left is a typical example of [illegible]dvanced welding practices employed at B&W for the fabrication of pressure vessels. B&W's history of resourceful engineering is distinguished by a 26-year-old succession of developments and improvements in welding machines, automatic controls, techniques, coating of electrodes, inspections, and tests.

B&W's leadership in welding—beginning in 1930 with the first welded boiler drum approved by an engineering authority for high-pressure operation—is being applied to an ever-broadening range of quality-welded vessels for high and low temperatures and pressures, and for corrosive services. Chances are B&W has the economical solution to your process equipment problems. The Babcock & Wilcox Company, 161 East 42nd Street, New York 17, N. Y.



BABCOCK & WILCOX

HOW CLAD STEEL TEAMWORK CUTS CORROSION AND COSTS



Two clad steels combine specialized talents to lick corrosion in this 20,000-barrel-per-day refinery unit

Selecting material for this two-stage refinery unit was a double-tough problem. The upper section of the atmospheric tower had to withstand the corrosive action of condensing mineral acids and organic chlorides . . . the lower part had to handle corrosive asphalt crude containing up to 2.50% sulphur concentrations. The vacuum still had to process a lube cut at 750°F. The equipment builder solved the corrosion problem *economically* by teaming up two clad steels: Monel-clad for the upper part and stainless-clad for the lower part of the atmospheric tower, and stainless-clad throughout the vacuum still.

With economical clad steel—a layer of solid high alloy permanently bonded over its entire surface to a low-cost carbon-steel backing plate—there is no possibility of seepage or crevice corrosion . . . no costly maintenance or downtime . . . no equipment failure. In addition, clad steels assure resistance to thermal shock, flexible efficient operation, low first cost and easy economical field erection.

Equipment values like these also result from another kind of teamwork. Sound engineering and modern fabricating techniques can take advantage of the versatility of clad steels. You will find that it pays to consult your fabricators *early* in your planning for tanks and pressure vessels. They can work with your engineers and consultants, translate ideas into the specialized equipment you require.

Ask one of your fabricators to show you the new Lukens clad steel movie, "Equip for New Profits." Here—in full color and sound—are factual accounts of how clad steel equipment brings new economies. The story can suggest new ideas to everyone concerned with production efficiency. Or contact Manager, Marketing Service, Lukens Steel Company, 681 Lukens Building, Coatesville, Pennsylvania.

LUKENS CLAD STEELS

STAINLESS-CLAD · NICKEL-CLAD · INCONEL-CLAD · MONEL-CLAD

PRODUCER OF THE WIDEST RANGE OF TYPES AND SIZES OF CLAD STEELS AVAILABLE ANYWHERE

TYPE EV SPEEDRANGERS are electronically-controlled, Thyraton type, adjustable-speed power drives with a wide range of operating speeds and good speed regulation.

SIZES. ⅛ to 1½ HP with basic speed of 2400 RPM.

SPEED RANGE. Drive speeds are adjustable down to one sixth of the basic speed for continuous duty, 50°C., down to one twentieth of the basic speed, intermittent duty.

HOW IT WORKS. Single phase AC power is converted by Thyraton type electronic rectifiers to supply a DC variable-speed drive motor. This DC drive motor is of the separately excited type, which inherently has good speed regulation.

STANDARD CHARACTERISTICS are constant torque rating over the full speed range . . . complete control from a compact operator's station . . . infinite steps of speed adjustment . . . smooth starting and good speed regulation.

OPTIONAL FEATURES are jogging, reversing, dynamic braking, wide or special speed ranges and special duty cycles.

New

electronic variable speed drives

TYPE GV SPEEDRANGERS are electronically-controlled, motor-generator type, adjustable-speed power drives with a wide range of operating speeds and good speed regulation.

SIZES. 2 to 10 HP with basic speeds of 2400, 1750 and 1150 RPM.

SPEED RANGE. Drive speeds are adustable down to one sixth of the basic speed for continuous duty, 50°C.; down to one tenth of basic speed intermittent duty.

HOW IT WORKS. Three or two phase AC power is converted by a motor-generator set and by tube type electronic rectifiers to supply a DC variable-speed drive motor. This DC drive motor is of the separately excited type, which inherently has good speed regulation.

OPERATION. The Type GV Speedrangers have the same standard characteristics and optional features as listed above for the Type EV Speedrangers.

MANY TYPES. The DC drive motor for both the Type EV and GV Speedrangers are available with Master Unibrakes, Fluid Drives and any of the five types of Master Gearmotors.

THE MASTER ELECTRIC COMPANY
DAYTON, OHIO

SIMPLE and EASY TO USE

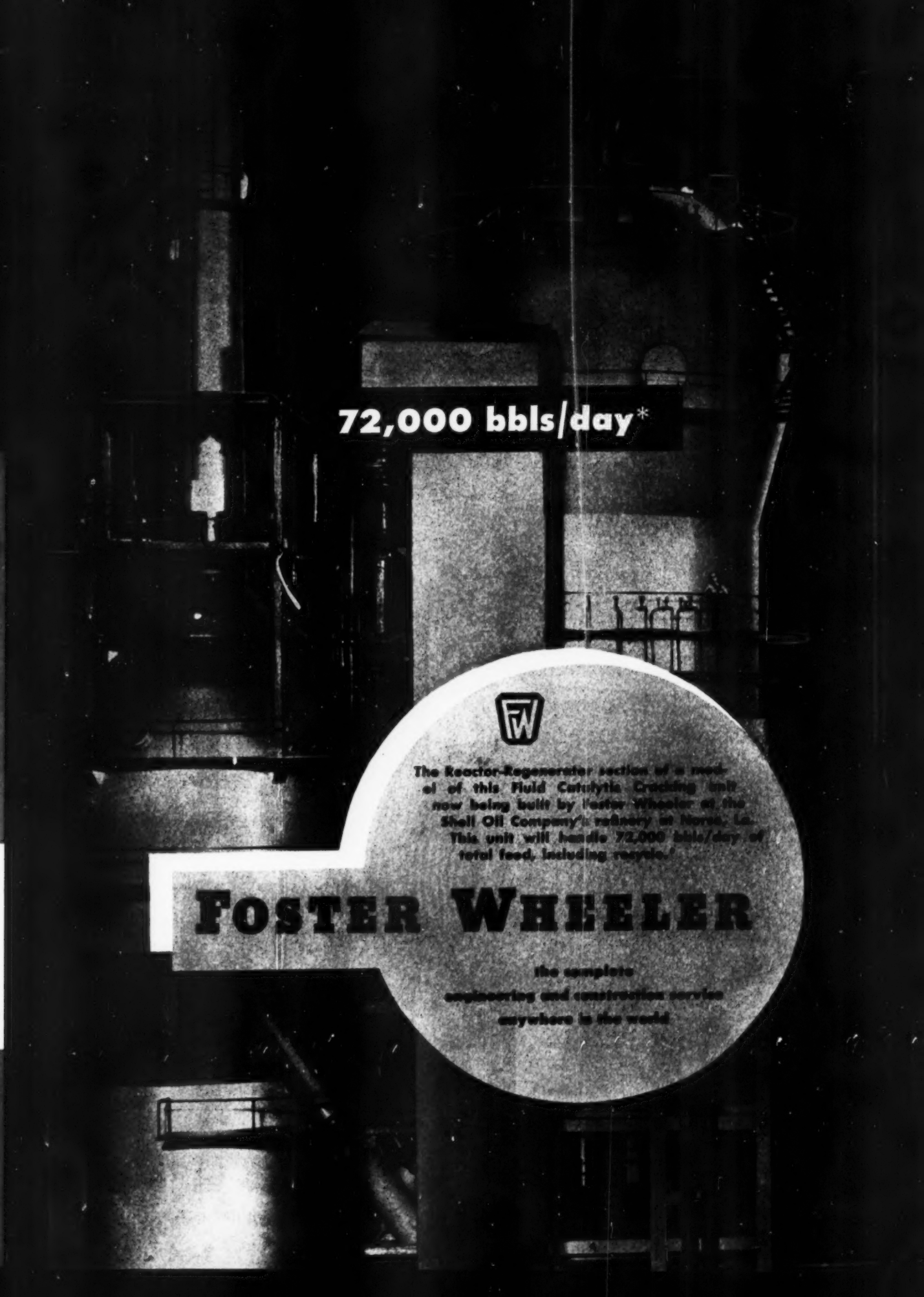
Midwest Reducing Elbow replaces two fittings (1) a straight size elbow and (2) a reducer. One weld is eliminated with a resultant saving in layout time, welding, and cost. Pressure drop is reduced, appearance is improved and the piping is easier to insulate. Sizes to 16", reductions to half size.

Children get the hang of a bubble pipe almost by instinct . . . it's so simple and easy to use. Pipe welders report that they find Midwest Welding Fittings simple and easy to use because they are so uniform . . . so accurate to dimension . . . and because of their greater variety. Representative of this greater variety is the Midwest Reducing Elbow (shown at right) which takes the place of a standard elbow and a reducer . . . requires only two welds instead of three. For more information on why Midwest Welding Fittings are simple and easy to use, ask for Catalog 54.

MIDWEST PIPING COMPANY, INC.
Main Office: 1450 South Second Street, St. Louis 4, Mo.
Plants: St. Louis, Passaic, Los Angeles and Boston
Sales Offices:
New York 7—50 Church St. • Chicago 3—79 West Monroe St.
Los Angeles 33—520 Anderson St. • Houston 2—1213 Capitol Ave.
Tulsa 3—224 Wright Bldg. • Boston 27—426 First St.
STOCKING DISTRIBUTORS IN PRINCIPAL CITIES

MIDWEST WELDING FITTINGS

MIDWEST
WELDING FITTINGS
Improve Piping Design and Reduce Costs


72,000 bbls/day*
The Reactor-Regenerator section of a model of this Fluid Catalytic Cracking unit now being built by Foster Wheeler at the Shell Oil Company's refinery at Norco, La. This unit will handle 72,000 bbls/day of total feed, including recycle.
FOSTER WHEELER
the complete
engineering and construction service
anywhere in the world

The Small Valve

THAT DOES THE

BIG JOB

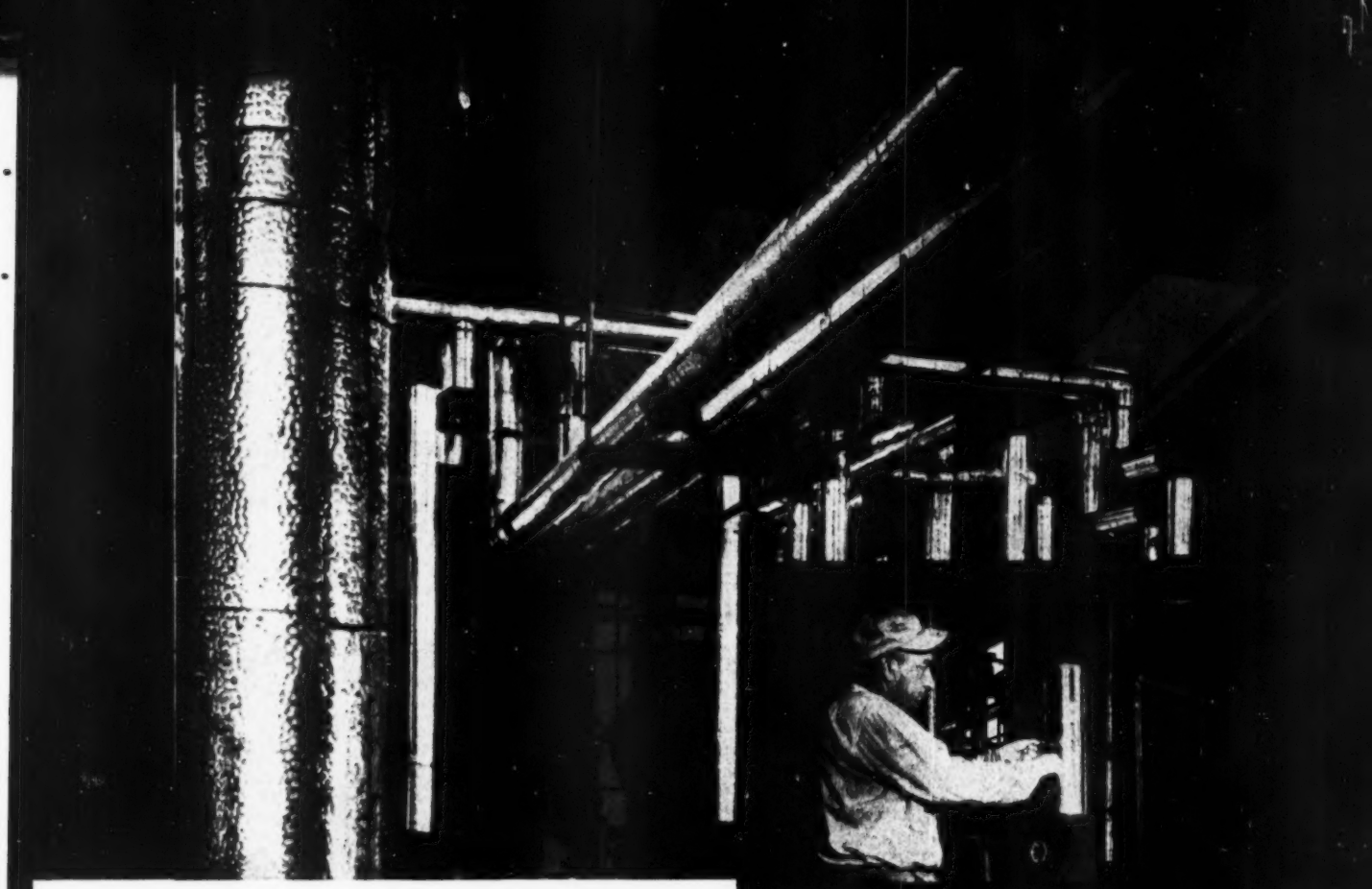
Here's what you get: Extra protection against excessive stress with new extra-strong stem and wedge-gate connection . . . super-hardened seat rings of stainless steel . . . forged body and yoke (and bolted follower that has no threads to corrode) . . . plus Malcomized gate faces that won't seize or gall. Made in sizes from ½" to 2" inclusive, with choice of rising stem with yoke, or with inside screw. Bonnet joints either gasketed or metal-to-metal. Pressure range: 2,000 lb. at 100°F. — 380 lb. at 1,000°F. For higher pressures, specify List 990. Write for Catalog 10.

The CHAPMAN VALVE MFG. COMPANY

INDIAN ORCHARD, MASS.

LIST 960

CHAPMAN



GENERAL TIRE & RUBBER COMPANY reports:

"WE SELECTED ALUMINUM-JACKETED FOAMGLAS FOR A PERMANENT, NEAT INSULATION JOB."

From The General Tire & Rubber Company's Baytown (Tex.) Plant comes this news: "In our new polymerization pilot plant FOAMGLAS insulation was installed on brine lines designed to operate at 0° F. Pittsburgh Corning's new *Aluminum*-jacketed FOAMGLAS pipe insulation was selected because we felt it would give us a permanent, serviceable and neat appearing job. We also used FOAMGLAS blocks to insulate vessels operating at 0° F. in this same plant."

You, too, should take advantage of the outstanding insulating performance of FOAMGLAS in *your* plant. For more details, use the coupon.

PITTSBURGH CORNING CORPORATION

One Gateway Center • Pittsburgh 22, Pa.

FOAMGLAS®

the cellular glass insulation . . . it stays dry!

Aluminum-jacketed FOAMGLAS offers these advantages:

1. **FASTER, CHEAPER APPLICATION:** factory-jacketed with aluminum, this new FOAMGLAS pipe covering gives you moisture-proof insulation, weatherproof jacket and attractive finish all-in-one.
2. **BEAUTIFUL LOW-COST FINISH:** Aluminum-jacketed FOAMGLAS gives you a most eye-appealing installation without the customary high costs required to give an attractive finish to ordinary insulations and field-applied jackets.
3. **LESS MAINTENANCE:** now the rot-proof, acid-proof qualities of FOAMGLAS are in the finish. The wrinkle-free aluminum surface takes abuse and is weather-resistant, sanitary, easy to clean, saves re-painting expense.
4. **EXTRA INSULATION:** aluminum's heat reflecting asset supplements the unequaled insulating properties of FOAMGLAS . . . the rigid, cellular glass insulation that *stays dry* inherently, retaining its original insulating efficiency.

Pittsburgh Corning Corporation, Dept. Z-24
One Gateway Center, Pittsburgh 22, Pa.

Please send me the following brand new FOAMGLAS literature:

- ☐ New bulletin and sample of Aluminum-jacketed FOAMGLAS.
- ☐ New folder on FOAMGLAS pipe insulation.
- ☐ New folder on FOAMGLAS insulation for tanks and other equipment.
- ☐ Send engineer to discuss specific problem.

Name _____

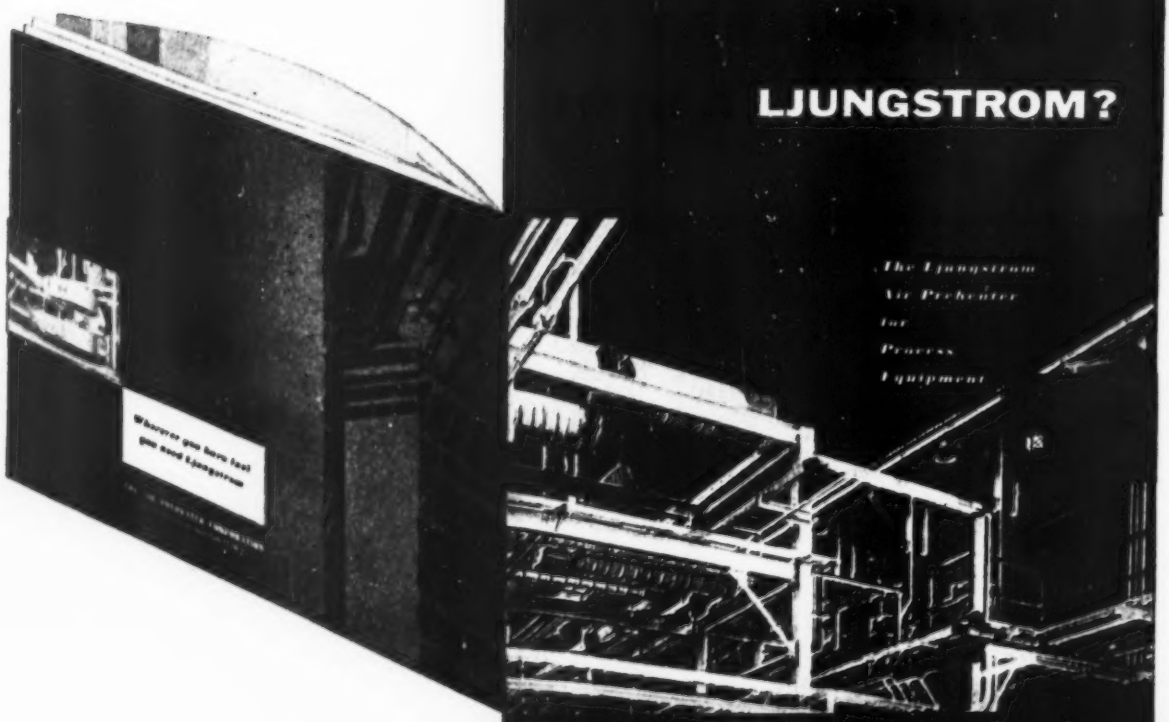
Company _____ Title _____

Address _____

City _____ Zone _____ State _____

this new book answers:

LJUNGSTROM?



You save up to 20% of your fuel costs alone on process units, for example. The Ljungstrom Air Preheater recaptures waste heat from stack gases and returns it to the furnace, thus reducing the quantity of fuel you need to maintain throughput. *There are three other cash advantages* with Ljungstrom, too. *Throughput increases* up to 25% . . . *octane rating increases* as much as two points . . . *maintenance costs are reduced* because of much lower rate of slag formation on furnace tubes. You'll find confirming details on these great savings — and more — in this book just published by The Air Preheater Corporation. Just ask for Catalog E-5.

WHEREVER YOU BURN FUEL, YOU NEED LJUNGSTROM

The Air Preheater Corporation, 60 East 42nd Street, New York 17, N. Y.

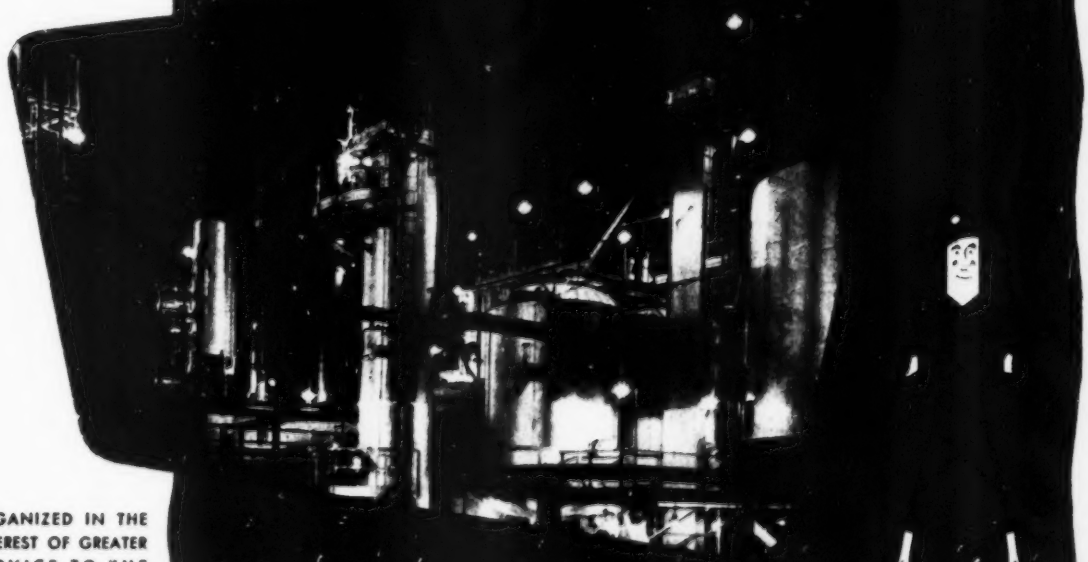
EFFICIENT, CLEAN,

DEPENDABLE ...LOW COST

PURCHAS

Electric Power

ANOTHER
Electric Power
CASE HISTORY

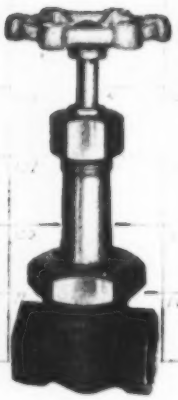


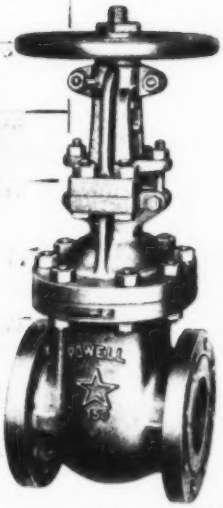
ORGANIZED IN THE INTEREST OF GREATER SERVICE TO THE PETROLEUM INDUSTRY

PETROLEUM ELECTRIC
POWER ASSOCIATION

Our 25th Year

DEPENDABILITY IN 2 LETTERS





TOP

LUBRICATED PLUG VALVE *(Fig. 2201)* Flanged end. Available with screwed or bolted glands. Semi-Steel valves available for 175 and 200 pounds W.O.G. Carbon Steel Valves available for 150 and 300 pounds W.P.

LEFT

BRONZE "WHITE STAR" GATE VALVE *(Fig. 375)* For 200 pounds W.S.P. Union bonnet with inside screw rising stem. Renewable "Powellium" Nickel-Bronze wedge. Sizes, ¼" to ¾", Solid Wedge; 1" to 3" Double Wedge.

RIGHT

CAST STEEL GATE VALVE *(Fig. 1503)* 150 pounds. Flanged ends, bolted flanged bonnet with outside screw rising stem and yoke. Solid wedge. Available in sizes 1" to 24", inclusive.

The life of a valve bears a certain relation to the life of the company that produces it. Powell has had a solid, oak-like growth for over a hundred years. That's only possible because The William Powell Company makes dependable valves.

Today, Powell Valves are proving their dependability in a greater variety of installations than any other valves in the world. And Powell is very likely the leader in research as well as development of special valves to overcome flow control problem situations.

All good reasons why PV, for Powell Valves, appears on more specifications year after year.

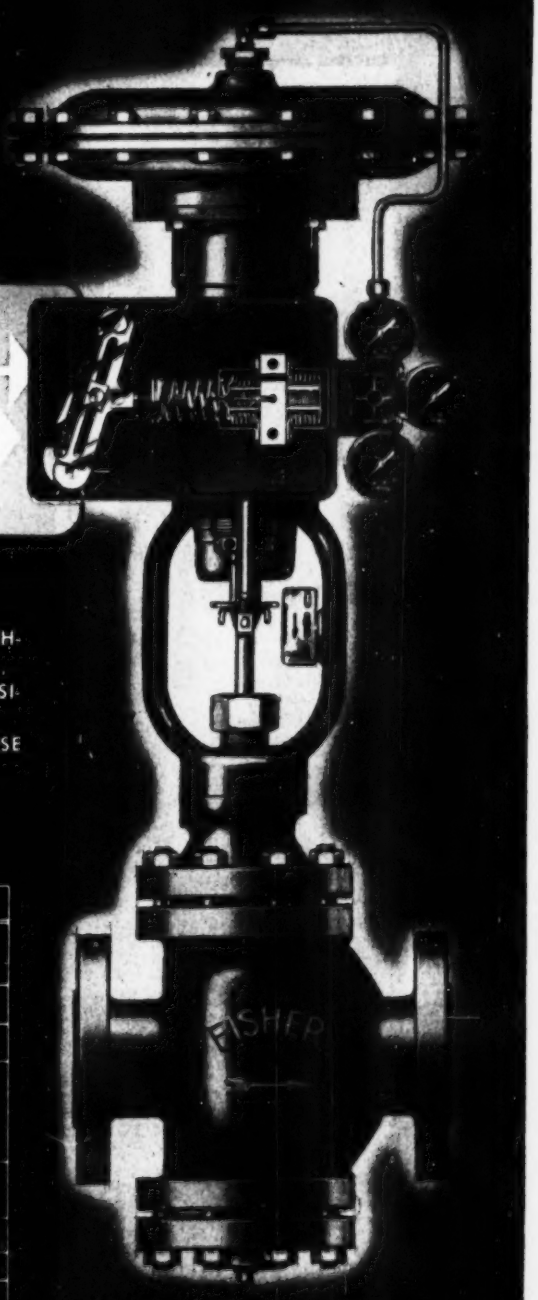
THE WILLIAM POWELL COMPANY
CINCINNATI 22, OHIO

CONTROLS FOR THE LIFE LINES OF INDUSTRY

.....108th YEAR

FISHER®
POSITROL®

FOR ACCURATE POSITIVE VALVE POSITIONING



FEATURES

- COMPACT — SIMPLE RUGGED
- 5 YEARS FIELD SERVICE
- EASILY ADJUSTABLE
- FORCE BALANCE TYPE OF POSITIONER
- AVAILABLE WITH OR WITHOUT BY-PASS
- USABLE AS REMOTE POSITION INDICATOR
- FOR DIRECT OR REVERSE ACTION VALVES

TECHNICAL DATA

TEST			FISHER TYPE 3500
INSTRUMENT PRESSURE SENSITIVITY CONTROLLING PRESSURE CHANGE NEEDED TO PRODUCE 2 LBS. TO 15 LBS. TO DIAPHRAGM			0.07 LB
STEM MOVEMENT SENSITIVITY AMOUNT STEM CHANGE TO PRODUCE 2 LBS. TO 15 LBS. TO DIAPHRAGM	½" TRAVEL		0.0037 AVE
	2" TRAVEL		0.015 AVE
SPEED TIME IN SECONDS FOR FULL TRAVEL	SIZE	TRAVEL	
	DD	½"	1.2 — 1.2 SEC
	FF	1"	4.2 TO 4.8 SEC
	GG	2"	7.2 SPC TO 9.6 SEC
	HH	2"	10.5 TO 12.6 SEC
LAG ERROR IN POSITION AT 9 LBS. CONTROLLER PRESSURE	½" TRAVEL		0.0006 AVE
	2" TRAVEL		0.001 AVE
EFFECT OF VARIATIONS IN AIR SUPPLY PRESSURE	½" TRAVEL		0.1 LB PER 5 LB CHANGE
	2" TRAVEL		0.1 LB PER 5 LB CHANGE
CHARACTERISTICS CONTROLLED P VS. DIAPHRAGM P			LINEAR
COMMENTS			STABLE ADJUSTMENTS ALL EASY AND SIMPLE
AIR CONSUMPTION NORMAL 9 LBS. DIAPHRAGM PRESSURE			15.0 CU FT/HR

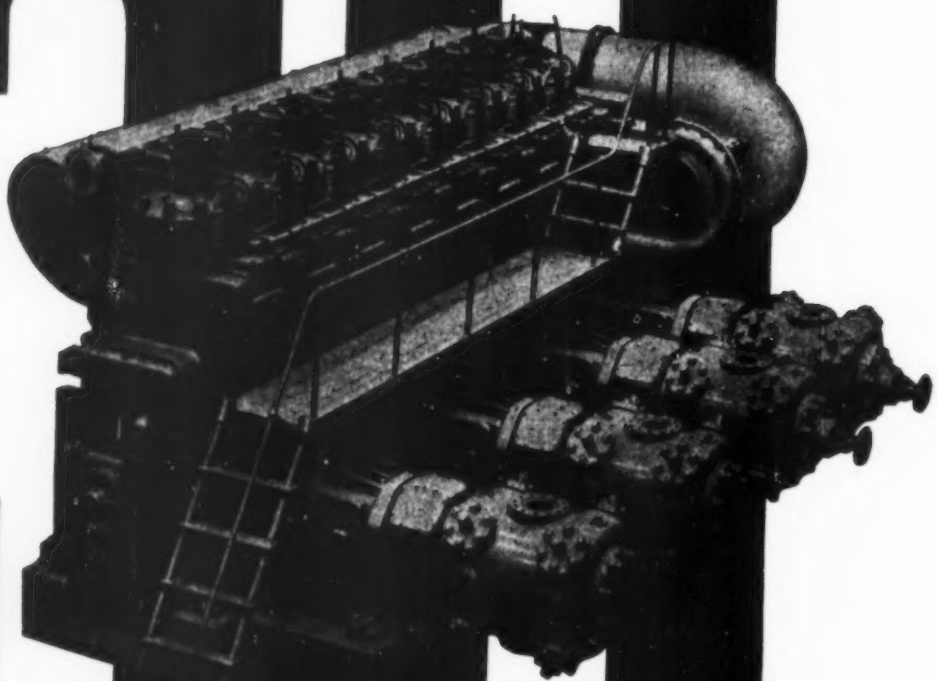
FOR COMPLETE DETAILS WRITE FOR BULLETIN E-3500

FISHER
GOVERNOR COMPANY
Marshalltown, Iowa

LEADS THE INDUSTRY IN RESEARCH FOR BETTER PRESSURE CONTROL

Since 1880

50%



more power!

with Clark Model TRA Compressors

Delivering substantially more power than any compressors of comparable displacement, the *new* Clark 2-Cycle Turbocharged Gas-Engine-Driven Compressors are the most important development in the industry today.

Boasting a 50% power increase over non-turbocharged units of comparable size, the Model TRA delivers 825 to 1650 bhp per unit. This tremendous increase in output is accomplished with no sacrifice of overload capacity or in the ruggedness and durability characteristic of *all* Clark Compressors. ***Actually, for their horsepower, Clark Turbocharged Compressors are the most rugged ever built.*** The conservative BMEP rating of 92, together with the massive construction of the Model TRA, bear this out.

Where units of even greater output are required, Clark offers the world's most powerful gas-engine-driven compressor—the Turbocharged Model TLA—rated at 2000 to 3300 bhp per unit. Compared to non-turbocharged compressors of the same displacement, the TLA produces 36% more power at the conservative BMEP rating of 101.

While power output is vitally important in compressor design, economy of operation is even more important. Clark Turbocharged Compressors burn 12½% less fuel and require slightly over half of the cooling water used by non-turbocharged units. From these and other unique advantages, it is not hard to visualize the important savings in installation and operation of Clark Turbocharged Compressors.

For complete details, call your nearest Clark representative or write for Bulletin 130.

CLARK BROS. CO. • OLEAN, N. Y.

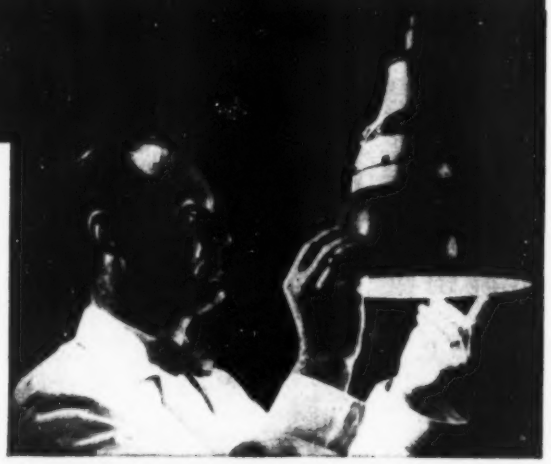
DIVISION OF DRESSER OPERATIONS, INC.

SALES OFFICES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

CLARK *Turbocharged Compressors*

Clark sets the pace in compressor progress

Rigid testing of *Explosion-Proof* CONDULETS *assures safety and long dependable service*



Pröbing for maximum exterior operating temperature on a Type EVA Explosion-Proof Lighting Fixture using a multiple point recording potentiometer.

Crouse-Hinds extensive laboratories and modern manufacturing combine to give you top quality

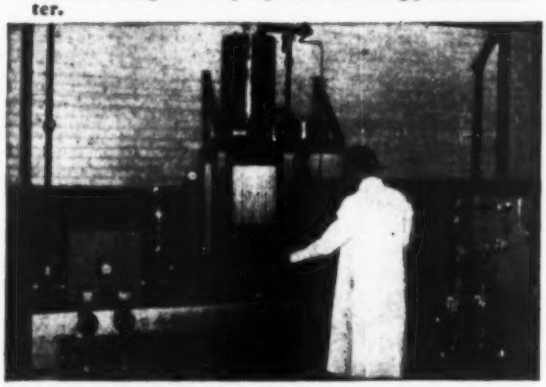
Laboratory testing is one of the key operations in the production of electrical equipment of the highest quality. Crouse-Hinds laboratories are equipped with the latest scientific instruments and staffed with expert technicians.

Products are constantly tested to make sure that they are being made to withstand field conditions. New devices are tested to predetermine their meeting or surpassing the requirements of Underwriters' Laboratories.

The photographs at the right show three of the many testing operations that are done in the Electrical Laboratory. It is equipped with apparatus for making both alternating and direct current tests, heat tests, pressure tests and many others.

Close cooperation between Crouse-Hinds laboratories and manufacturing departments is one of the reasons why Condulets have been the "Standard of Quality" for nearly fifty years.

Specify CONDULETS on every job. They're made right ... to serve you better ... and last longer.



Adjusting carburetors and flow meters to create a predetermined explosive mixture within an explosion-proof Condulet for an explosion test.

When quality counts
... you can count on Condulets

Photographing the pressure wave in the Oscilloscope to determine the maximum explosion pressure within an explosion-proof Condulet that is behind the concrete wall.

CROUSE-HINDS COMPANY
Syracuse 1, N. Y.

OFFICES Birmingham – Boston – Buffalo – Chicago – Cincinnati – Cleveland – Dallas – Denver – Detroit – Houston – Indianapolis – Kansas City – Los Angeles – Milwaukee – New Orleans – New York – Philadelphia – Pittsburgh – Portland Ore. – San Francisco – Seattle – St. Louis – St. Paul – Tulsa – Washington. RESIDENT REPRESENTATIVES Albany – Atlanta – Baltimore – Charlotte – Corpus Christi – Reading Pa. – Richmond Va. – Shreveport – Crouse-Hinds Company of Canada Ltd. Toronto Ont.

CONDULET
First in the field
STANDARD OF QUALITY

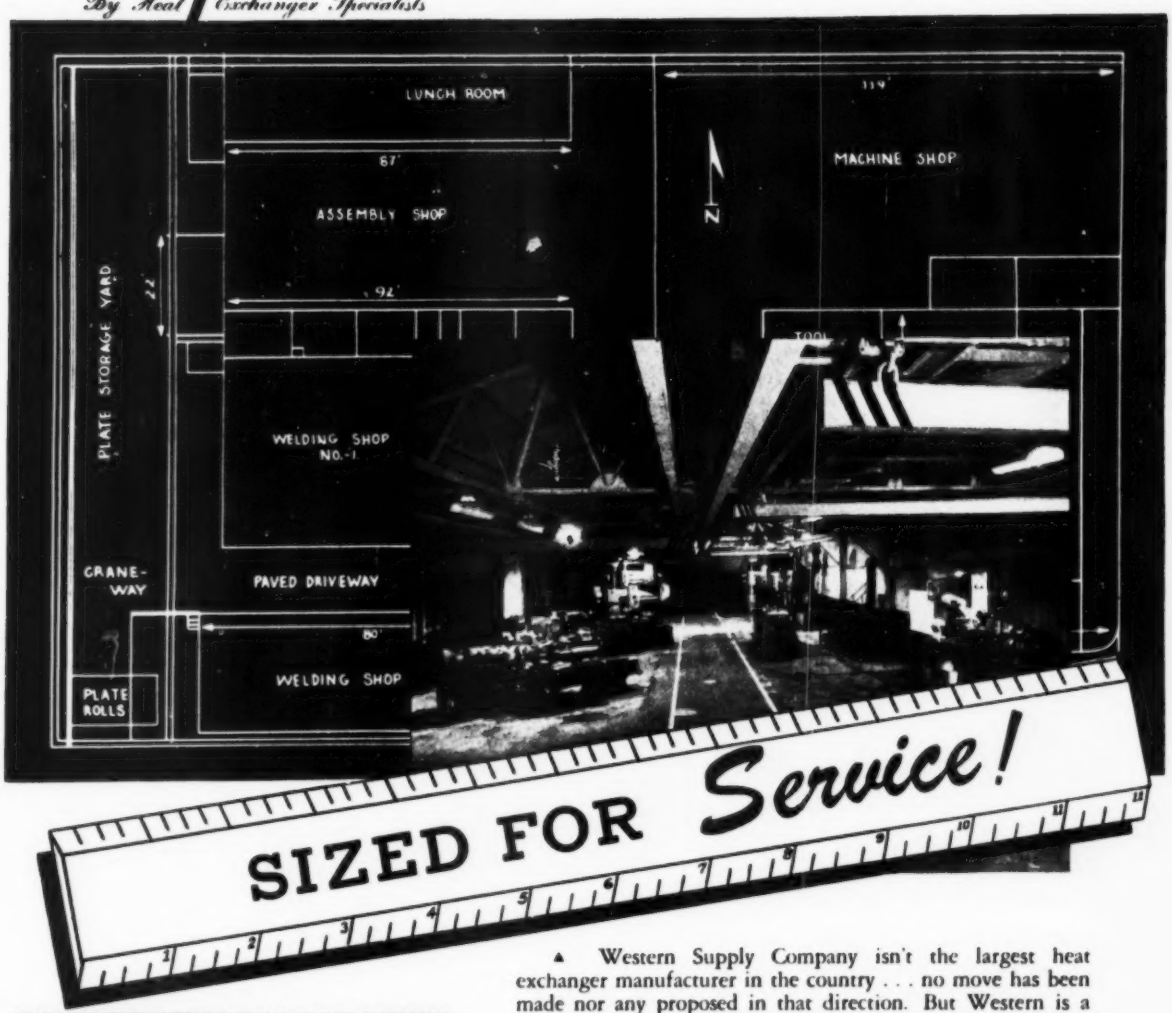
*CONDULETS are made only by CROUSE-HINDS

A Nationwide Distribution Through Electrical Distributors

CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS

By Heat Exchanger Specialists

▲ SYNOPSIS OF AD #1: Western Supply Company of Tulsa, Oklahoma, started as a small machine shop in 1906. The growth of the Southwestern oil country supported the small operation, and in 1936 Western began building heat exchangers for the pipeline industry. This specialized fabrication soon expanded to encompass the refining, chemical and petrochemical fields.



▲ Western Supply Company isn't the largest heat exchanger manufacturer in the country . . . no move has been made nor any proposed in that direction. But Western is a company with a *planned* facilities program, and, since World War II, the addition of the latest mills, lathes, rolling, bending and welding equipment have earned it the reputation of one of the most modernly equipped heat exchanger plants in the United States.

Because of its moderate size and the degree of control it exercises over the heat exchangers it is to build, the plant is truly "sized for service" and offers its customers a flexibility and speed invaluable on emergency or deadline fabrication. Working in both common and alloy metals, Western designs and manufactures for the high pressures and temperatures of today's processing requirements.

WESTERN HEAT EXCHANGERS

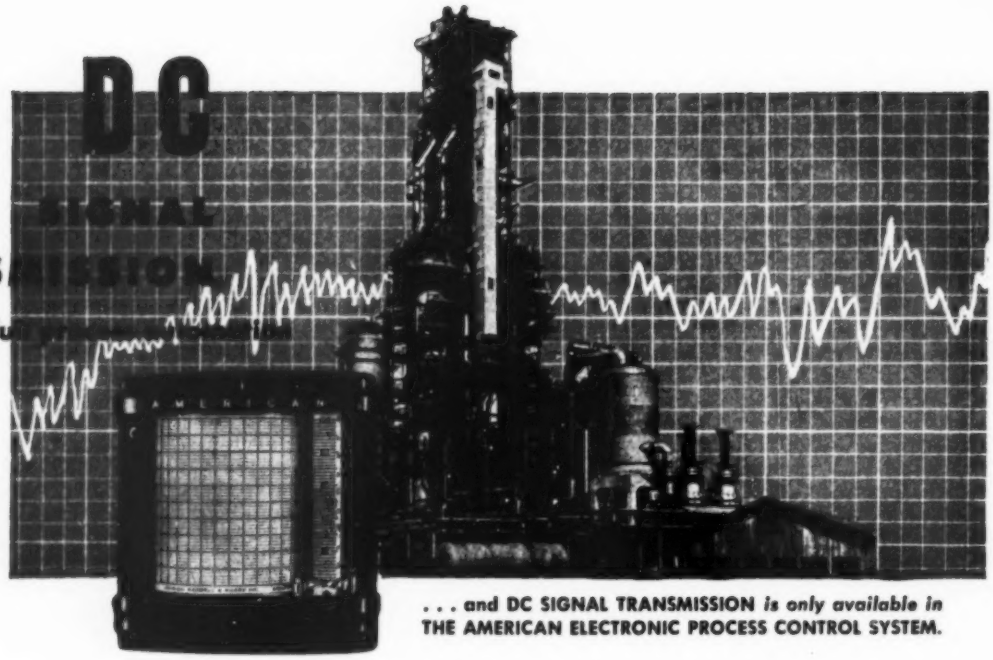
WESTERN SUPPLY CO.

P. O. BOX 1888 • TULSA, OKLAHOMA

2nd in a new series of advertisements

DC SIGNAL TRANSMISSION

the key to fu



. . . and DC SIGNAL TRANSMISSION *is only available in* THE AMERICAN ELECTRONIC PROCESS CONTROL SYSTEM.

Most modern electronic print-out, monitoring and computing equipment is designed for DC operation. Until recently it was impractical to integrate these automatic devices with instruments that measure process variables. Consequently, complete process automation was impossible.

Now—the new American Electronic Process Control System provides the major compatability factor essential to achieve the economic advantages of full process automation: *DC signal transmission.*

The instantaneous DC transmission of process variable measurements permits higher controller gains that result in a new concept of control performance. At the same time, it makes possible the efficient "electric nerve center" so essential to the low-cost operation of the ultra modern plant of today and the standard plant of the future. In short, the American Electronic Process Control System provides the only practical foundation for integration of . . .

1. **AUTOMATIC LOGGING** — the continual listing of operational data in tabulated digital form.
2. **AUTOMATIC MONITORING** — the centralized supervision of all measured criteria for maximum safety and efficiency.
3. **AUTOMATIC COMPUTING** — for precise accounting and engineering analysis at highest speed and lowest cost. Ushers in the fully automatic plant with completely automatic product analysis and control.

In addition to this unique versatility, the American Electronic Process Control System offers *improved quality of control*—tighter control that opens the way for a reduction in the size of process equipment and consequently a lower capital investment for a given through-put. Furthermore — *simplified communication* — with two-wire DC signal transmission lines that are unaffected by induced alternating currents and varying line resistance, the cost and complexity of present systems will be vastly reduced.

When you select process control equipment, basic considerations are performance, initial installed cost, reliability, maintenance, and flexibility. The advanced design and operation of all instruments in the American Electronic Process Control System assure complete satisfaction on every count. Convince yourself. *Write for Catalog No. 164.*

AMERICAN INDUSTRIAL INSTRUMENTS

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

AEROCAT®

MS SYNTHETIC CRACKING CATALYST

Among the 97 fluid cat cracking units in operation in the U. S. during 1953, some 65 used AEROCAT MS Synthetic Cracking Catalyst—for three reasons.

First, because AEROCAT is the surest, most economical means to:

- ★ high octanes
- ★ high throughput
- ★ low CO_2/CO ratio in flue gas
- ★ high iso butane yield
- ★ excellent heat, steam and sulfur stability

Second, because Cyanamid—producer of AEROCAT and pioneer in microspheroidal catalysts—has the research facilities, the technical service staff, *and the experience* required to develop solutions to individual application problems.

Third, because Cyanamid can be relied upon as a source of supply.

If you're not already a user of AEROCAT (chances are 2 out of 3 that you are), contact your Cyanamid Technical Service representative soon. He'll be happy to help you secure the economy and efficiency of AEROCAT in your cracking operation.

And among those who use synthetic catalyst, more than 8 out of 10 use AEROCAT.

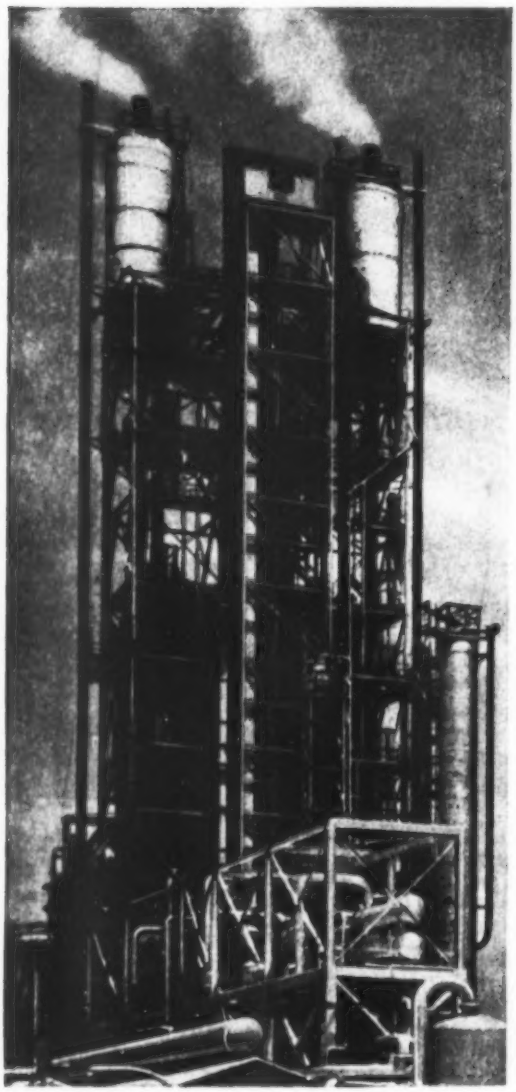
AMERICAN *Cyanamid* COMPANY

REFINERY CHEMICALS DEPARTMENT

30 Rockefeller Plaza, New York 20, N.Y.

In Canada: North American Cyanamid Limited, Toronto and Montreal

when you install catalytic cracking equipment —



investigate the economy

of **TENAMENE**

inhibitor-sweetening

Nearly all catalytically cracked gasolines respond to Tenamene inhibitor-sweetening—The economy inherent in this single sweetening-gum inhibiting process should be considered by all refiners now constructing or contemplating the construction of cat-cracking units. Important factors which may influence your plans are.

Double function—Tenamene 2 acts both as antioxidant to inhibit gum formation, and as a sweetening agent.

Low cost—only 5 lbs. of Tenamene 2 per 1000 barrels of gasoline usually are needed... about ½¢ per barrel.

Low installation cost—the Tenamene process is so simple, very little basic equipment is needed.

Savings on maintenance and operation—these costs are negligible compared to most other processes.

No octane loss—no danger of the presence of free sulphur —as in some processes.

No gasoline loss—no addition of chemicals at elevated temperatures.

No deleterious chemicals added—such as sulphur or copper.

PROMPT SERVICE: Eastman's highly qualified technical staff and modern gasoline laboratories are at your service. We welcome the opportunity to discuss Tenamene inhibitor-sweetening with you at your convenience. Contact your local representative or write to Eastman Chemical Products, Inc., Kingsport, Tennessee—a subsidiary of Eastman Kodak Company.

Tenamene EASTMAN GASOLINE ADDITIVES

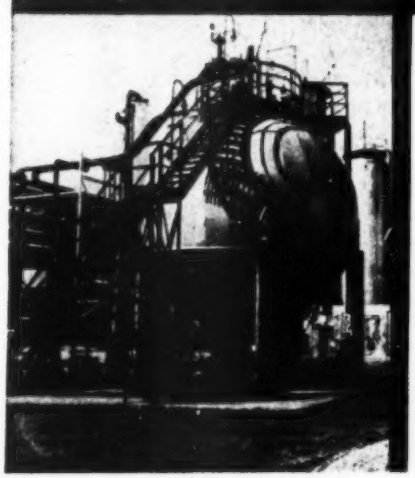
SALES OFFICES: Eastman Chemical Products, Inc., Kingsport, Tenn.; New York—260 Madison Ave.; Framingham, Mass.—7 Hollis St.; Cincinnati —Carew Tower; Cleveland—Terminal Tower Bldg.; Chicago—360 N. Michigan Ave.; St. Louis—Continental Bldg.; Houston—412 Main St. **West Coast: Wilson Meyer Co.,** San Francisco—333 Montgomery St.; Los Angeles—4800 District Blvd.; Portland—520 S. W. Sixth Ave.; Seattle—821 Second Ave.

24 REFINERS INCREASE DAILY THROUGHPUT WITH PETRECO DESALTING

In one refinery after another, Petreco desalting has promoted operational savings. The resulting fast "pay outs" have rendered the cost of the desalting installation virtually incidental. These fast pay outs result from one basic factor – *Petreco desalting enables the refinery to run more crude.*

The table below shows typical results of Petreco desalting in twenty-four refineries recently surveyed. These refineries charge a wide variety of crudes. Note the barrels of crude run per day – before, and after, desalting. Note the number of days on stream – before, and after, desalting. Note the percent increase in throughput. Why not have these benefits in your refinery? They easily pay for the cost of desalting, and result in substantially more profitable operations.

No.	TYPE OF CRUDE	GRAV. °API	BBLS. PER CAL. DAY		% INCREASE	NO. OF DAYS ON STREAM	
			BEFORE DESALTING	AFTER DESALTING		BEFORE DESALTING	AFTER DESALTING
1	OKLA. ASPHALT	16	950	1,900	100.0	1	75
2	TALCO, WINNSBORO	21	10,500	14,000	33.0	14	360
3	STEPHENS, ARK.	29	1,200	2,000	66.6	10	90
4	SO. LA. SWEET	38	11,000	13,000	18.2	100	125
5	NO. TEXAS SWEET	37	6,760	7,540	11.5	26	78
6	KANSAS SWEET	30+	3,360	3,820	13.7	37	125
7	MICHIGAN LIGHT	44	3,000	4,000	33.3	18	180
8	MIXED CRUDES	16-38	13,000	17,000	30.8	90	180
9	NO. TEXAS-OKLA.	40	8,000	10,000	25.0	33	145
10	GULF COAST	33	15,000	17,500	16.7	..	..
11	WEST TEXAS, SOUR	32	3,900	4,900	25.5	30	180
12	OKLAHOMA, SOUR	20	1,960	2,840	45.0	30	90
13	SHULER, ARK.	33	15,800	18,000	14.0	7	150
14	NEW MEXICO, SOUR	35	1,350	2,150	59.0	..	..
15	WEST TEXAS, SOUR	34	1,000	2,500	150.0	10	40
16	MICHIGAN	38	2,800	3,500	25.0	2	60
17	HASTINGS, SO. TEXAS	31	31,102	41,184	32.4	29	65
18	NO. TEXAS, OKLA.	40	4,000	4,940	23.5	90	180
19	MID CONTINENT	37	4,450	4,950	11.2	45	225
20	RANGER, NO. TEXAS	41	6,000	8,000	33.3	..	..
21	WEST BRANCH, MICH.	33	1,500	3,000	100.0	4	30
22	MICHIGAN	37	14,300	22,100	54.5	..	..
23	SANTA MARIA	14	2,200	2,700	22.7	60	365
24	WEST TEXAS, SOUR	33	1,850	2,750	48.5	90	365



The only "cheap" feature of Petreco desalting is the cost. Equipment, engineering and service are the best obtainable – that's why Petreco desalting is cheapest in the long run. Get complete information today. Write or call

Petrolite Corporation
PETRECO DIVISION
3202 So. Wayside Drive, Houston 1, Texas
1390 E. Burnett St., Long Beach 6, California

PETRECO

ELECTRIC PETROLEUM PROCESSING

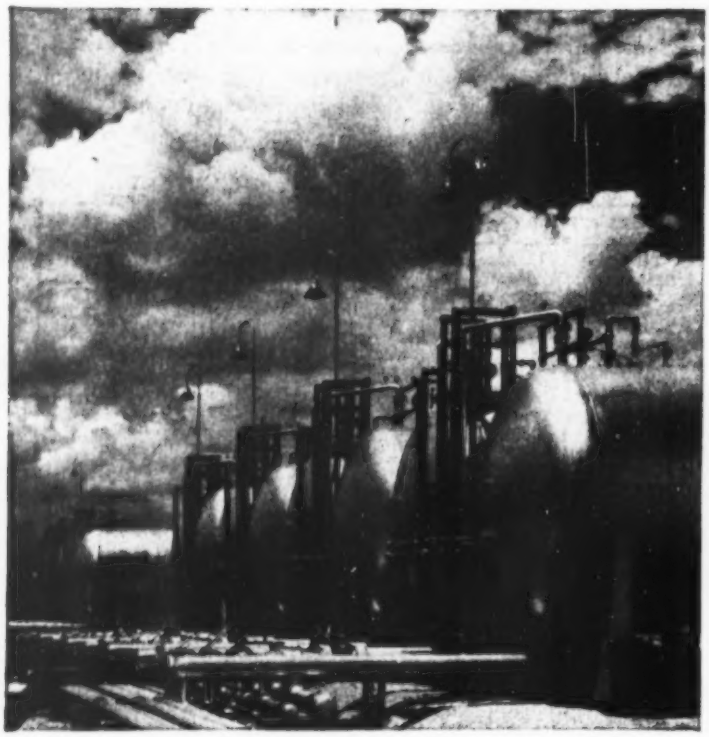
CRUDE OILS: REMOVAL OF SALTS, SOLIDS, OTHER IMPURITIES; DEHYDRATING
DISTILLATES: ACID TREATING; CAUSTIC TREATING; DOCTOR TREATING
FUEL OILS: DESAPONIFICATION, ASH REMOVAL

PS 53-1

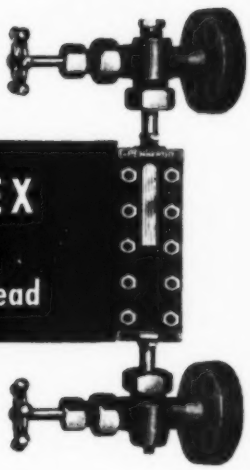
For any pressure...in any length

SPECIFY PENBERTHY

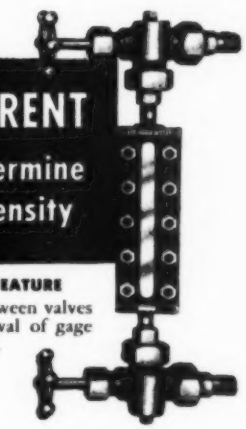
LIQUID LEVEL GAGE SETS



TUBULAR
Meets Navy specifications



REFLEX
Accurate, easy-to-read



TRANSPARENT
Quickly determine color and density

DON'T MISS THIS FEATURE
Union connections between valves and gage permit removal of gage without shutting down.

Corrosion-resisting Penberthy gages and valves indicate accurately the level in vessels containing any kind of liquid. Construction is exceptionally sturdy. Materials conform to or exceed requirements of A.I.S.I., A.S.T.M. and/or A.P.I.-A.S.M.E. for maximum recommended pressures and temperatures. They are made from carbon steels, high grade bronze and malleable iron. Also available are chrome-moly and stainless steels and Monel metal. When specified, materials such as acid bronze, Everdur, nickel and Hastelloy are supplied.

For your special requirements, experienced engineering counsel and service are available to design and make valves and gages to meet your unusual conditions.

● For most requirements, Catalog 35 is a handy help in selecting and ordering. A copy will be sent upon request.

Established 1886

PENBERTHY INJECTOR COMPANY

Division of the Buffalo-Eclipse Corporation

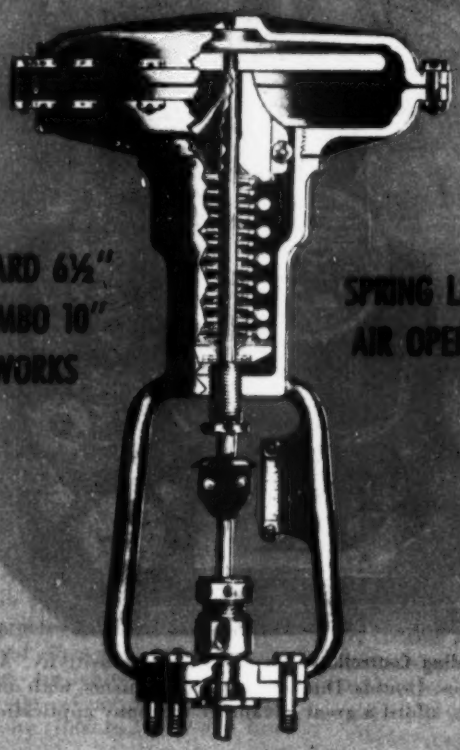
1264 Holden Avenue, Detroit 2, Michigan

There's Certain satisfaction in **PRODUCTS BY**

PENBERTHY

- **CYCLING JET PUMPS**
- **EJECTORS**
- **INJECTORS**
- **ELECTRIC SUMP PUMPS**
- **EDUCTORS**
- **EXHAUSTERS**
- **SYPHONS**

FOR BETTER CONTROL
USE BS&B CLIMAX
TYPE 86-TW DIAPHRAGM OPERATORS



STANDARD 6½" OR JUMBO 10" TOPWORKS

SPRING LOADED AIR OPERATED

This versatile Climax Type 86-TW Diaphragm Operator is a modified version of the controlling mechanism of the famous BS&B Climax Type 86 Control Valve. It has been adapted for use with a variety of other valves, instruments and controls such as butterfly valves, diaphragm valves (Saunders Patent), engine throttles and other controls where controlling pressure is available for translation to reciprocating motion.

Available in either the Standard 6½" or Jumbo 10" size, this versatile topworks is spring loaded and operates from compressed air or other medium. Yoke, spring case, diaphragm case and plate are of high tensile cast iron. Stems are of stainless steel with brass connector of unique construction. Diaphragm is of cotton or nylon neoprene. Roller bearings on the spring guide reduce friction loss to a minimum.

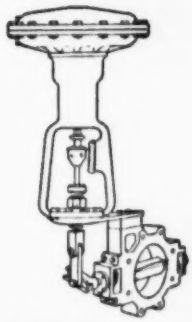
For more complete information on the Climax Type 86-TW Diaphragm Operator or on other Climax Controls, call your BS&B Man or Sales Representative, or write to . . . .

BS&B CLIMAX CONTROLS OVER 40 YEARS

BLACK, SIVALLS & BRYSON, INC.

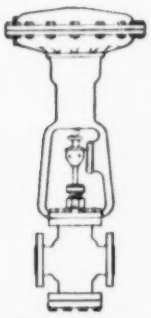
Climax Controls Division Dept. 4-F2

7500 East 12th St. Kansas City 26, Missouri



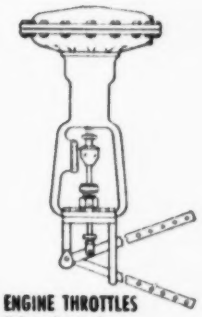
FOR BUTTERFLY VALVES

Climax Type 86-TW Diaphragm Operator is ideal for automatic control of butterfly valves. Mounts easily on any make of valve, and can be set for any specified operation of the valve.



FOR DIAPHRAGM VALVES

First developed for use on diaphragm valves, Climax Type 86-TW Diaphragm Operator has large diaphragm area and variable spring loading to insure minimum hysteresis.



FOR ENGINE THROTTLES and Other Controls

Wherever a sensitive yet positive reciprocal controlling motion is needed, such as on engine throttles, speed governors, cooling tower weirs, valve levers, etc., the versatility and adaptability of the Climax Type 86-TW Diaphragm Operator make it the ideal selection.

The most popular of all

DEPENDABLE

RUGGED

EASY, LOW COST MAINTENANCE

SIMPLE ADJUSTMENTS

VERSATILE

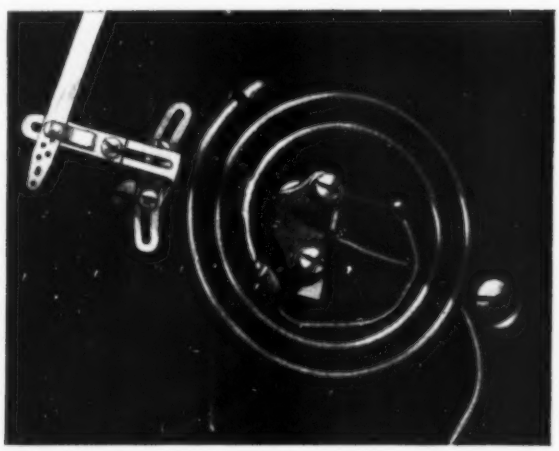
TROUBLE-FREE

SIMPLE OPERATION

LONG LIFE

Single Duty FULSCOPE Recording Controller with Adjustable Sensitivity, Automatic Reset and PRE-ACT responses. Double Duty control mechanisms, with *any* combination of control responses, afford a great advantage on many applications.

Sensitivity adjustment unit; single, continuous adjustment calibrated in specific units.



Improved sub-base permits easy, precise replacement of pre-calibrated actuating systems in field.

instruments celebrates its 15th BIRTHDAY!

THANKS to you, the Taylor FULSCOPE* Controller today enjoys unrivaled popularity. We say thanks to you because this instrument was designed to meet your exacting requirements as determined by an industry-wide survey. The result is dependable performance year after year, and low maintenance cost. In the petroleum industry, natural gasoline plants particularly, these instruments are relied upon to operate automatically for hours on end unattended. Thus the operators are freed to take care of other maintenance duties.

For the benefit of those who are new in positions of responsibility in the selection of instrumentation, here are some of the reasons why Taylor Series 100 FULSCOPE Controllers have been able to meet these exacting requirements and consequently reign supreme throughout industry.

ADAPTABILITY

1. Extremely versatile. The same control mechanisms are available for Temperature, Pressure, Flow and Liquid Level—in either recording or indicating models, as locally mounted controllers, transmitters or controlling receivers. Interchangeable unit construction permits a small inventory of parts. Pre-calibrated units eliminate expensive checking. Easy visibility and accessibility of components means an instrument man can have a unit back on the job with minimum down time.

2. Adaptable to any control problem because the FULSCOPE Controller has three control effects:

(a) Proportional Response—available in three forms: Fixed High Sensitivity (1000 psi per inch pen movement): Adjustable Sensitivity (1000 to 1 psi); and Limited Range Sensitivity (400 to 30 psi). **(b) Automatic Reset Response,** completely and continuously adjustable (.05 to 5 repeats per minute). **(c) PRE-ACT* Response** (rate action) continuously adjustable within the range of 0.2 to 10 mins. All the adjustments are wide range and continuous. Any combination of these control responses may be used to provide any required quality of control. PRE-ACT and reset units are interchangeable.

3. Proper Adjustment Easily Obtained. Control Response Adjustment Dials are calibrated in specific units, repeatable in all instruments. Optimum settings are quickly determined.

4. Controller action simply changed by lifting a spring clip and rotating set-point knob.

DEPENDABLE OPERATION

5. Control point always matches set point when automatic reset is used, thanks to fully pneumatic sensitivity reduction. Lowering sensitivity for stability does not reduce the effectiveness of the reset response. Result—control point always returns to set point, regardless of load changes.

6. Trouble-free air system. Metal disc type filters are built-in features, easily removed for cleaning. Both relay air valve and nozzle are made of 18-8 stainless steel. A simple system, made of corrosion resistant parts, easily accessable for cleaning.

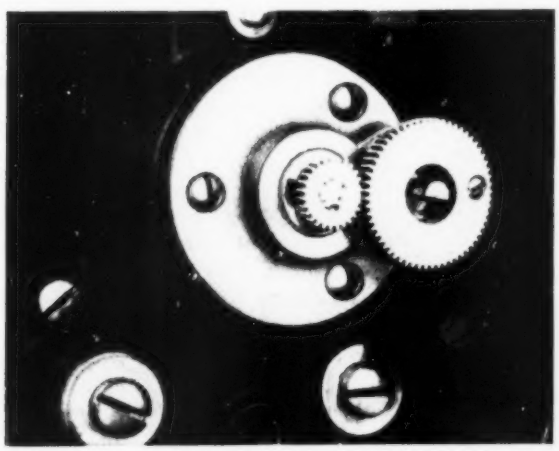
7. Lifelong Accuracy. Fewer links and pivots. Dead spot and hysteresis practically non-existent due to lightweight stainless steel link and small diameter burnished pivots. This lightweight construction nullifies vibration effects. Spring pivot clips, which do not gum up or corrode, replace screws. Over and under-range linkage protection provided when required.

Whether your processing problems are simple or complex, there's a Taylor instrument or control system and a competent Taylor Field Engineer ready to help you solve them.

Write for Bulletin 98151. Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.

Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.

*Reg. U. S. Pat. Off

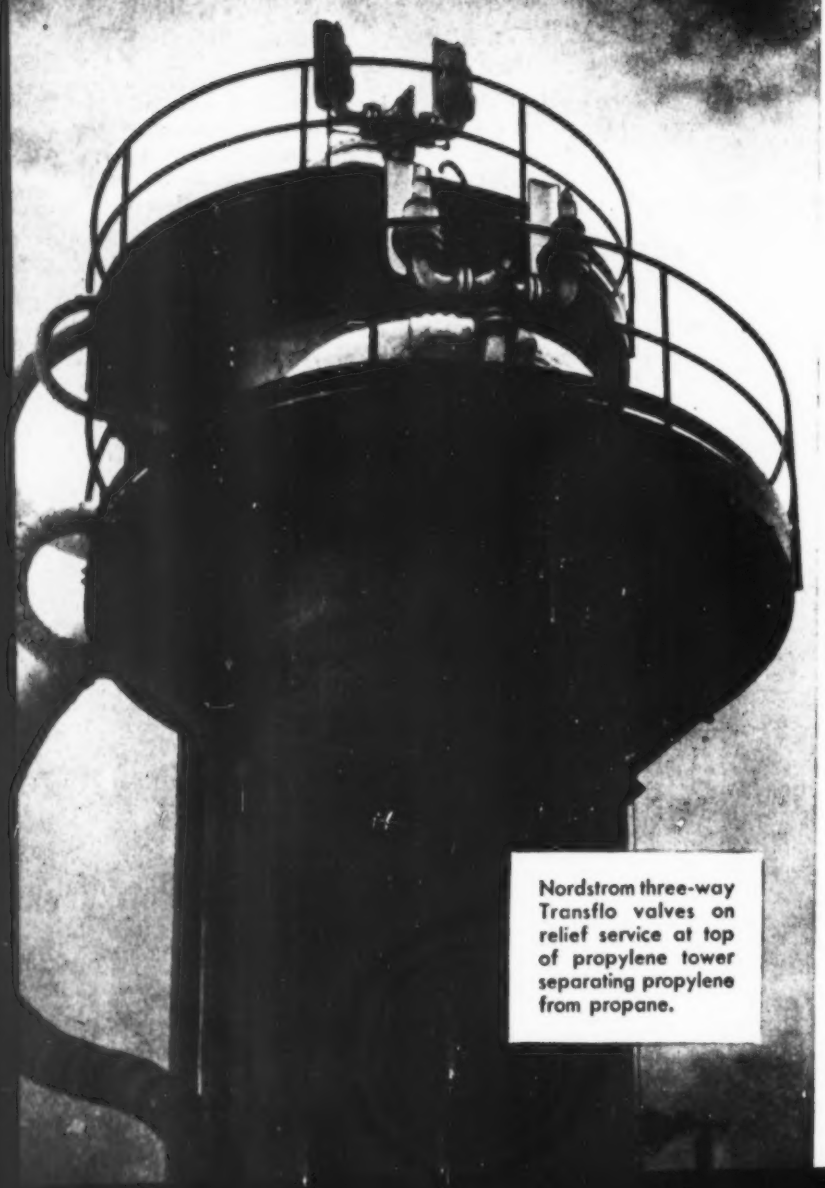


Interchangeable needle valves in Automatic Reset and PRE-ACT units.

Taylor Instruments
MEAN ACCURACY FIRST

THESE TWO EXAMPLES SHOW YOU

What Nordstrom Means by "Lubricaut



Nordstrom three-way Transflo valves on relief service at top of propylene tower separating propylene from propane.

TYPICAL NORDSTROM REFINERY APPLICATIONS

- Catalytic Polymerization
- Crude Topping and Vacuum Distillation
- Fluid Catalytic Cracking and Gas Recovery
- Distillate Recovery in Cycling Plants
- Duo-Sol Solvent Extraction
- Houdriflow Catalytic Cracking and Gas Recovery
- Light Ends Fractionating
- Thermal Cracking
- Phenol Extraction
- Propane Deasphalting
- Cycloversion
- Delayed Coking
- Girbotol Process
- Propane Dewaxing
- Hydroforming Process
- Naphtha Polyforming
- Solexol Process
- Solvent Dewaxing
- Thermal Reforming

Nordstrom has compiled a series of specification sheets for each of these processes, showing recommended materials, pressure classes, lubricants and valve figure numbers. Ask your Nordstrom sales engineer to review them with you.

TYPICAL NORDSTROM PROCESS INDUSTRY APPLICATIONS

- Beverage Plants
- Cement Plants
- Chemical Plants
- Explosives
- Food Plants
- Gas Plants
- Ice and Refrigeration
- Paint and Lacquer
- Paper and Pulp
- Pharmaceuticals
- Power and Steam Plants
- Rubber Plants
- Sewage Plants
- Smelters and Mines
- Soap Factories
- Steel Mills
- Sugar Refineries
- Synthetic Ammonic
- Synthetic Fibers
- Synthetic Plastics
- Synthetic Rubber
- Tanneries
- Textiles and Dyes
- Water Works

The new Nordstrom Corrosion-Resistant Valve Bulletin V-217 will make it easy for you to fit the right valve to each service. Write for a copy, Rockwell Manufacturing Company, Pittsburgh 8, Pa., or ask your Nordstrom sales engineer.

-Sealed for POSITIVE SHUT-OFF"

Here are two typical Nordstrom valve process applications—one is a propylene tower, the other a dry hydrogen line.

They illustrate an important point in specifying valves for process service . . . if really tight shut-off of hard-to-hold gases or fluids is important, no valve can do the job better than Nordstrom.

Why? Because Nordstrom is the original lubricated plug valve. Nordstrom is the valve with the extra seal of plastic lubricant around the valve ports to check seepage of even the lightest, most penetrating substances.

That, of course, means greater safety, and greater economy, too, because when leakage is prevented, valve life is far longer. And most important, it means uninterrupted operation of continuous process units—no down-time for avoidable valve repairs.

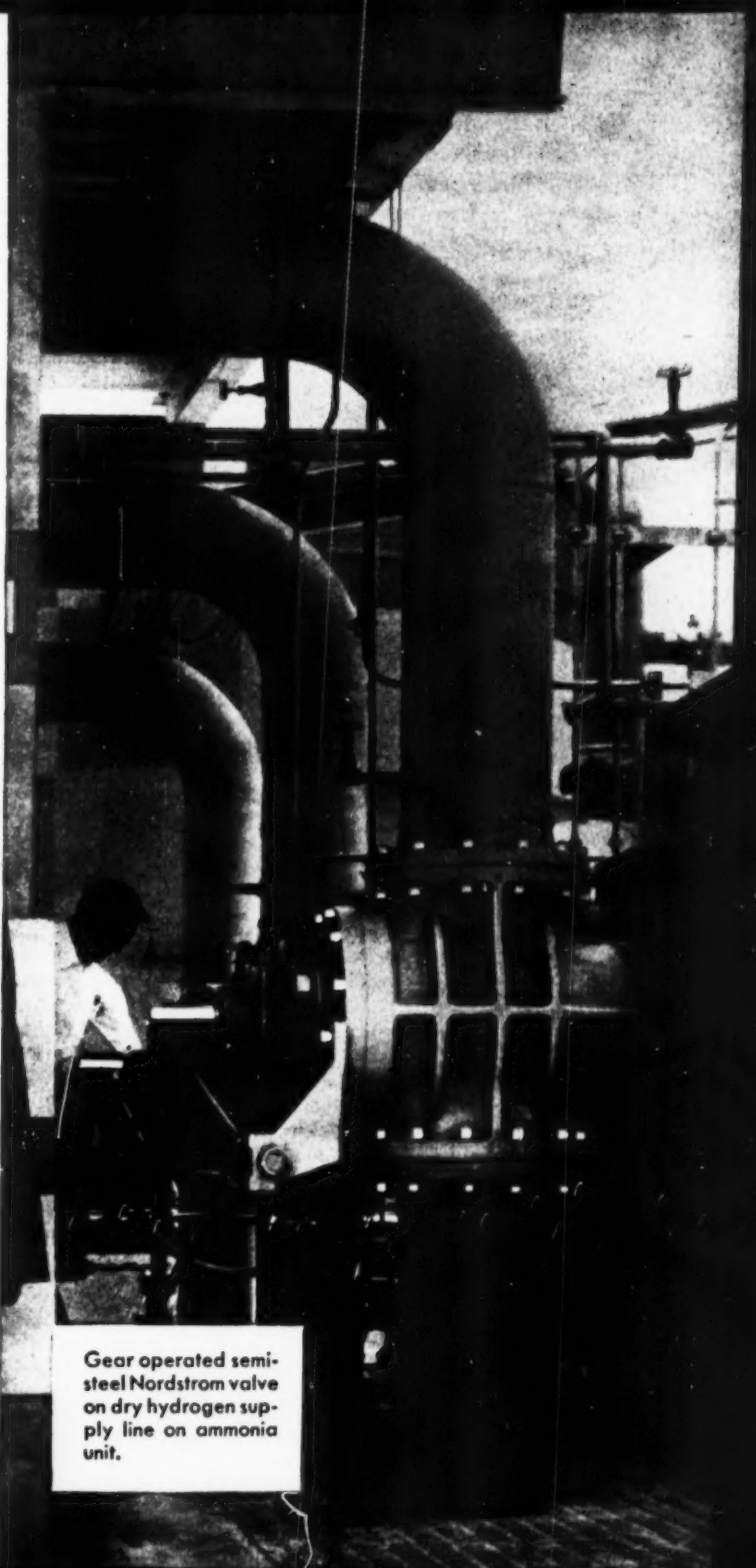
The same lubricant that seals, also keeps the valve ready to operate in an emergency.

Nordstrom valves are built in a wide range of sizes, pressures, special metals and body designs for the process industries, including three- and four-way designs for batching, blending and switching. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

Canadian Licensee: Peacock Brothers Limited

ROCKWELL Built
Nordstrom Valves
Lubricant-Sealed for Positive Shut-Off

Another Rockwell Product



Gear operated semi-steel Nordstrom valve on dry hydrogen supply line on ammonia unit.

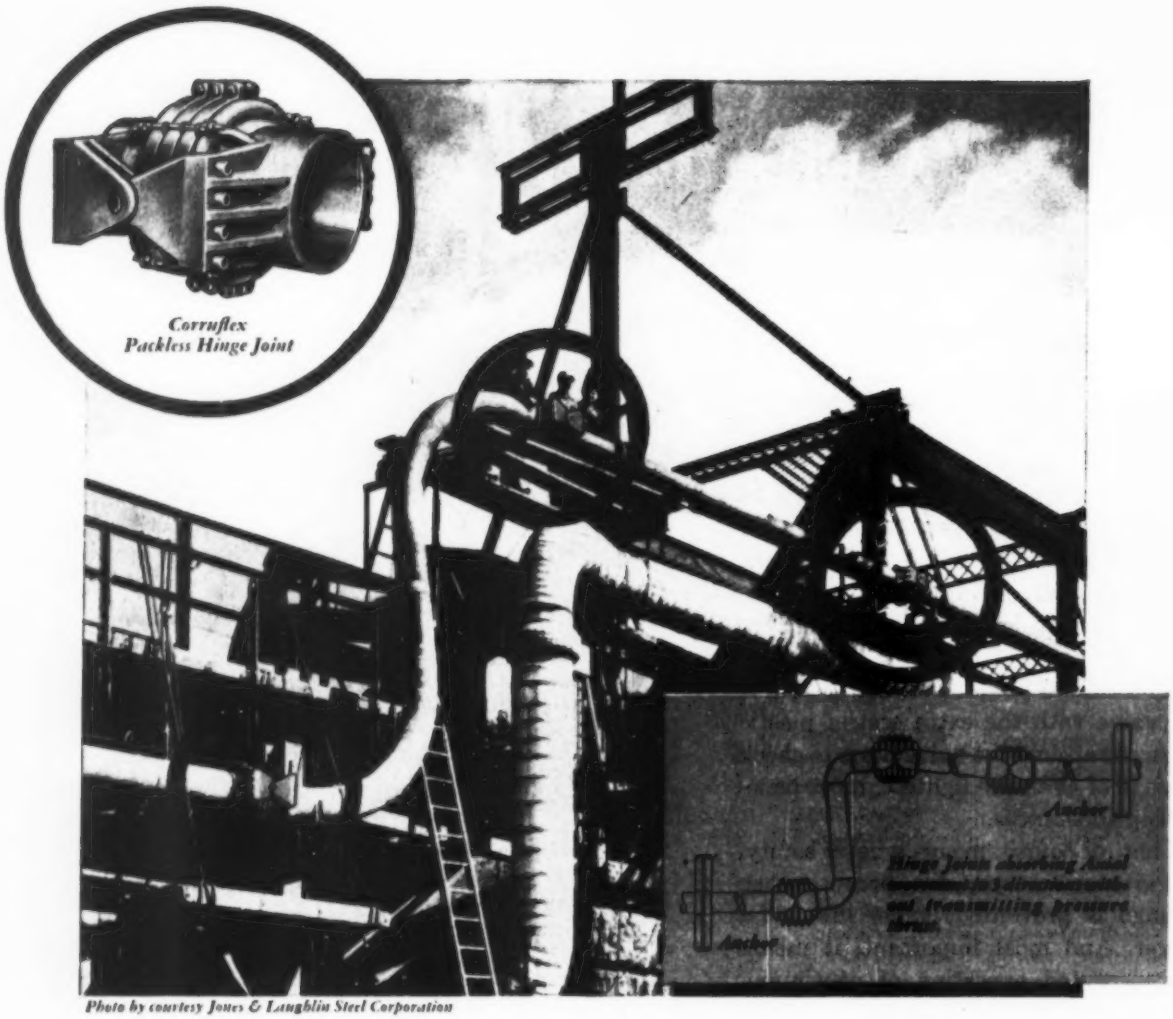


Photo by courtesy Jones & Laughlin Steel Corporation

HINGING A 14" STEAM LINE

● The Jones & Laughlin Steel Corp. in Pittsburgh last year had an excess of steam on one side of the Monongahela River and not enough on the other, where it was vitally needed. To correct this condition, J & L engineers planned to construct a high-pressure, superheated steam line along existing bridges and trestles to transmit the excess of steam to the other side.

However, a great difficulty soon appeared. If conventional expansion joints or loops were used at the 90° turns, pressure thrusts at anchor points would have been great enough to damage the bridges and trestles and actually cause these structures to collapse into the river.

Obviously, something else had to be used. With the aid of Adsco's Engineering Department, J & L "hinged" the pipe line with Corruflex Hinge Joints. These joints cannot develop pressure thrust because their two ends are held apart. They permit movement of a pipe line while keeping anchor loads at a minimum. When used properly, as pictured here, they will permit axial motion of one section of pipe line by permitting angular motion of another section.

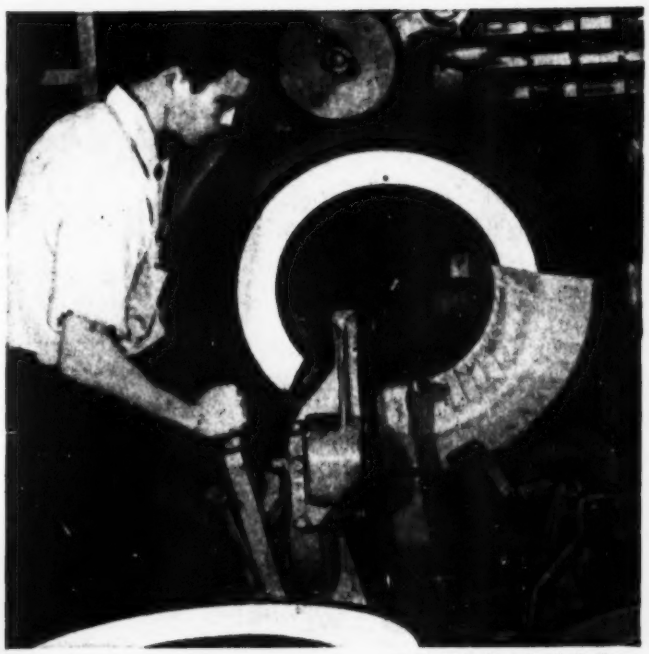
Hinge Joints are only one type in the diversified Corruflex line of packless expansion joints. If you have a pipe expansion problem, consult Adsco. Making the world's most complete line of expansion joints, both slip and packless, Adsco will have the right answer.

ADSCO
ENGINEERED
PRODUCTS

AMERICAN DISTRICT STEAM COMPANY, INC.

GENERAL OFFICES
NORTH TONAWANDA, NEW YORK
PLANTS
NORTH TONAWANDA, N. Y., AND RICHMOND, CALIF.

Motor Oil and Gasoline (Additives)



Synthetic Rubber, Synthetic Yarns

Paint, Varnish and Shellac

To add the ingredients of success...specify

ENJAY

34 successful years of leadership in serving industry

Get assured success—back your product with the research, experience and proved results of a pioneer leader. The Enjay Company not only supplies many different industries with a complete line of petrochemicals—Enjay also is ready to assist in the application of its products and in developing new or improved products to meet industry requirements. You can count on high quality Enjay chemical products—be sure to call Enjay for your chemical needs.

ENJAY COMPANY, INC. • 15 West 51st Street, New York, 19 N. Y.

for a complete line of high quality chemical products

PETROLEUM

PARANOX
PARATONE
PARAFLOW
PARAPOID
PARADYNE
PARATAC
PETROHOL
Methyl Ethyl Ketone
Dewaxing Aid
Ethyl Ether
Isopropyl Ether
Reference Fuels

SURFACE COATING

PETROHOL 91
PETROHOL 95
PETROHOL 99
JAYSOL
Secondary Butyl Alcohol
Secondary Butyl Acetate
Isopropyl Acetate
Acetone
Methyl Ethyl Ketone
Ethyl Ether
Isopropyl Ether
Dicyclopentadiene
Naphthenic Acids
Iso-Octyl Alcohol
Decyl Alcohol
Denatured Ethyl Alcohol

CHEMICAL

PETROHOL 91
PETROHOL 95
PETROHOL 99
JAYSOL
Iso-Octyl Alcohol
Decyl Alcohol
Denatured Ethyl Alcohol
Tridecyl Alcohol
Dicyclopentadiene
Isoprene
Butadiene
Ethyl Ether
Isopropyl Ether
Tripropylene
Tetrapropylene
Aromatic Tars
Benzene
Acetone
Methyl Ethyl Ketone

"I'll call METAL GOODS– they're our best bet!"

Most Completely Rounded Warehouse Stocks

More and more users of metals are discovering Metal Goods Corporation's large and varied warehouse stocks the "best bet" for *all* their metal needs. Metal Goods carries a heavy inventory in aluminum, stainless steel, steel, nickel*, monel* and inconel*, brass, copper, and industrial products. We invite you to give your company the full benefit and big convenience of this *one-call buying* advantage. You can rely on us to supply your requirements correctly, completely and quickly. May we serve you?

*Not sold in St. Louis or Kansas City

7 warehouses and 9 sales offices to serve you

METAL GOODS CORPORATION

call your nearest office:

OFFICES AND WAREHOUSES

St. Louis 15, Missouri
5239 Brown Avenue
Nelson L. Hower
Phone: GOodfellow 1234

Kansas City 16, Mo.
1300 Burlington
Frank D. Hogan
Phone: NOrday 3516

Dallas 9, Texas
6211 Cedar Springs Rd.
Sam D. Hodgdon
Phone: ELmhurst 3271

Tulsa 3, Oklahoma
302 North Boston
Scott J. Harrison
Phone: 4-4101

Denver 2, Colorado
2425 Walnut Street
Neal Dahn
Phone: AComa 5891

Houston 3, Texas
711 Milby Street
Harris T. Gregg
Phone: CEntral 8881

New Orleans 12, La.
432 Julia Street
Carl T. Wedemeyer
Phone: CAnal 7373

SALES SERVICE OFFICES

Wichita, Kansas
2200 East Central
Ray Noller
Phone: AMherst 7-8921

Decatur, Illinois
1305 West Sunset
Arlie W. Tempel
Phone: 8-1314

Beaumont, Texas
238 Bowie Bldg.
Lee T. Dodson
Phone: 4-7536, 4-7537

San Antonio, Texas
2012 Alamo Natl. Bldg.
Charles I. MacKenzie
Phone: GArfield 3161

Memphis, Tennessee
713 Columbian Mutual Tower Bldg.
Robert W. Downs
Phone: 5-8721

Fort Worth, Texas
3821 Carolyn
John M. Turbitt
Phone: FOrtune 4369
FOrtune 5326

Corpus Christi, Texas
Room 301-02 Wilson Bldg.
Roy D. Bagaley
Phone: 4-0366

Jackson, Mississippi
781 Raymond Road
George E. Akerberg
Phone: 5-2711

Omaha, Nebraska
3515 No. 67th Avenue
C. M. Cooley
Phone: WAlnut 1112

Bettendorf, Iowa
P. O. Box 181
Harry L. Newton
Phone: 5-1232

Des Moines, Iowa
2600 Woodland
W. P. Crowley, Jr.
Phone: 4-9923

GENERAL OFFICES: ST. LOUIS 15, MISSOURI

DU PONT

PETROLEUM CHEMICALS DIVISION NEWS

DU PONT

February ★ One of a Series of Interest to the Petroleum Industry ★ 1954

DEALERS will be able to keep him sold on your brand of gasoline with the aid of this new Du Pont folder.

Giving a satisfactory answer to poor starting complaints is a tough proposition for the average dealer. To help him handle the situation in a salesmanlike way, this new 4-page folder will give him the answers he needs—in a short, clear-cut fashion that is easy to remember.

Ask your Du Pont Petroleum Chemicals Division representative for a sample copy and information on obtaining a quantity for your dealers.

New, Comprehensive Booklet on Antioxidant Sweetening Now Ready

Since antioxidant sweetening offers many cost reduction and quality advantages over other sweetening methods, many refiners have asked us for technical information on the subject.

To fill these requests, Du Pont has prepared a comprehensive booklet on antioxidant sweetening. It contains more information on this process than ever before published in a single volume.

Cost-Saving Data

The booklet gives information on how you can reduce operating and sweetening equipment costs through the use of Du Pont Antioxidant No. 22. It also shows how you can reduce loss in gasoline or octane number through the efficient use of the process . . . as well as sweeten and inhibit your product in a single step.

Helpful Hints

The booklet fully explains the variables encountered in antioxidant sweetening. Helpful hints on how to control these operational variables for best results are also included. These will help you save considerable time and money in getting the process started in your refinery.

This basic, authoritative text on antioxidant sweetening is yours for the asking. Address your request for "Antioxidant No. 22 Sweetening" to any of the Du Pont Petroleum Chemicals Division regional offices.

Du Pont Publishes New Book on Medical Aspects of Tetraethyl Lead Operations

The first and only book of its kind . . . produced as an aid to refinery medical personnel

There has long been a need for a book of specialized information on the medical aspects of tetraethyl lead handling. With this in mind, three of Du Pont's physicians who specialize in tetraethyl lead problems have collaborated in bringing out a volume which covers this subject in an authoritative and comprehensive manner. The title is, "Maintaining Hygiene in Tetraethyl Lead Operations."

CONCISE, LOGICALLY ORGANIZED and written in a direct, clear style, "Maintaining Hygiene in Tetraethyl Lead Operations" can be extremely helpful to refinery physicians in explaining lead hazards and precautions to refinery personnel.

In spite of the toxicity of tetraethyl lead, an enviable health and safety record has been established by the refinery workers who regularly come in contact with this chemical. The chief aim of the new book is to help the petroleum industry maintain this outstanding record.

Safety As A *Way Of Life*

The theme of the volume suggests that *preventive* medicine — rather than medical care — is the real core of a successful industrial medical program. Its chief emphasis is, therefore, on helping refinery doctors and safety personnel *prevent* accidents resulting from improper or careless handling of tetraethyl lead.

But to prepare the refinery medical staff for *any* emergency related to lead poisoning that may arise, the text also

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

DU PONT

PETROLEUM CHEMICALS DIVISION
NEWS

DU PONT

CONTINUED

Medical Book

includes specific data on the symptoms and treatment of poisoning from organic lead.

A Useful Reference

"Maintaining Hygiene in Tetraethyl Lead Operations" is a practical reference manual on a highly specialized field of industrial medicine.

Refinery doctors will find it extremely useful, for example, in setting up procedures for examining and advising workers in tetraethyl lead areas.

30 Years Experience

The Du Pont Company has been directly concerned with the manufacture and handling of tetraethyl lead for more than 30 years. It is from this experience — combined with constant, thorough study of the problems involved — that the authors of this book have drawn their material.

In addition to their work with employees in Du Pont's tetraethyl lead manufacturing area, the three authors of the book — Drs. Stewart L. Rankin, Lawrence A. Gerlach and Fenton Russell — have worked closely with refinery medical staffs on safe TEL handling procedures for many years.

THIS NEW Du Pont medical book is printed and bound, for durable use, between hard covers.

Limited Distribution

"Maintaining Hygiene in Tetraethyl Lead Operations" was written expressly for and addressed primarily to doctors in the petroleum industry to whom it will be distributed during the course of the year. A limited number of copies will also be distributed by Du Pont to oil company executives directly concerned with safety and medical procedures in the handling of tetraethyl lead.

Assistant Mid-Continent Regional Manager

DONALD W. FRISON, recently appointed assistant manager of the Petroleum Chemicals Division's Mid-Continent Region, has been with the Du Pont Company since 1947.

His first assignment with the company was as manager of the Mid-Continent District Laboratory. In 1951 he was transferred to the Wilmington office as technical assistant to the director of sales. He later became assistant manager of sales promotion and then assistant to the sales manager.

Before joining Du Pont, Mr. Frison was engaged in CFR engine work and refined petroleum products analysis at the Florida State Petroleum Laboratory. He graduated from the John B. Stetson University in Deland, Florida with a B.S. degree in chemistry.

During World War II, he was a petroleum officer in the U. S. Navy Bureau of Ships and was engaged in tanker loadings at the New York petroleum pool. Mr. Frison is a member of the Society of Automotive Engineers.

New Tank-Cleaning Safety Presentation Available to Refiners

Constant vigilance is *a must* for all personnel engaged in cleaning leaded gasoline storage tanks. But workers easily become bored—and sometimes careless—when safety rules and procedures are presented over and over again in the same old way.

To help overcome this situation, Du Pont has prepared a new, interest-arousing tank cleaning presentation. Our representatives first teach your own training staff how to use this tool—then leave it with you for use as you see fit. It is a penetrating, easy-to-understand training piece that your foremen can use with the tank cleaning crew for "tool box" safety meetings *on the site.*

Turn-Over Style

To make the presentation easy to handle and interesting to present, it has been put together in turn-over style. Copy of the talk and guides for the speaker are printed in large type on the back of each page. Pages facing the audience are illustrated either with colored cartoons or large sized photos of actual operations. All necessary safety precautions and procedures pertaining to the lead hazard are fully covered.

Distribution of the presentation will be limited to those responsible for the safety and training of tank cleaning crews. If you are interested in this important safety aid we suggest you get in touch with the nearest Du Pont Petroleum Chemicals Division regional office at once.

DU PONT
REG U.S. PAT. OFF.

Better Things for Better Living
. . . through Chemistry

Petroleum Chemicals

E. I. DU PONT DE NEMOURS & COMPANY (INC.)
Petroleum Chemicals Division • *Wilmington 98, Delaware*

Regional Offices:

NEW YORK, N. Y.—1270 Ave. of the Americas	Phone COlumbus 5-3620
CHICAGO, ILL.—8 So. Michigan Blvd.	Phone RAndolph 6-8630
TULSA, OKLA.—1811 So. Baltimore Avenue	Phone Tulsa 5-5578
HOUSTON, TEXAS—705 Bank of Commerce Bldg.	Phone PRestan 2857
LOS ANGELES, CALIF.—612 So. Flower St.	Phone MAdison 1691

IN CANADA: Canadian Industries Limited—Toronto, Ont.—Montreal, Que.—Calgary, Alta.
OTHER COUNTRIES: Petroleum Chemicals Export—Nemours Bldg., 6539—Wilmington 98, Del.

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

A-6688

Printed in U.S.A.

Multi-stage Buell Collector for catalyst recovery engineered to eliminate the need for supplementary collection equipment.

Still 'tops'

In Catalyst Recovery

For both fluid and thermofor catalytic cracking Buell high-efficiency cyclones continue to function successfully in separating catalyst materials from the vapor stream. All major oil refineries are included in Buell's customer list. For complete information on all types of dust collection and recovery write: Buell Engineering Company, Dept. 21-B, 70 Pine Street, New York 5, N. Y.

buell®

MECHANICAL ELECTRICAL

20 Years of Engineered Efficiency in

CATALYST RECOVERY

Completing Our

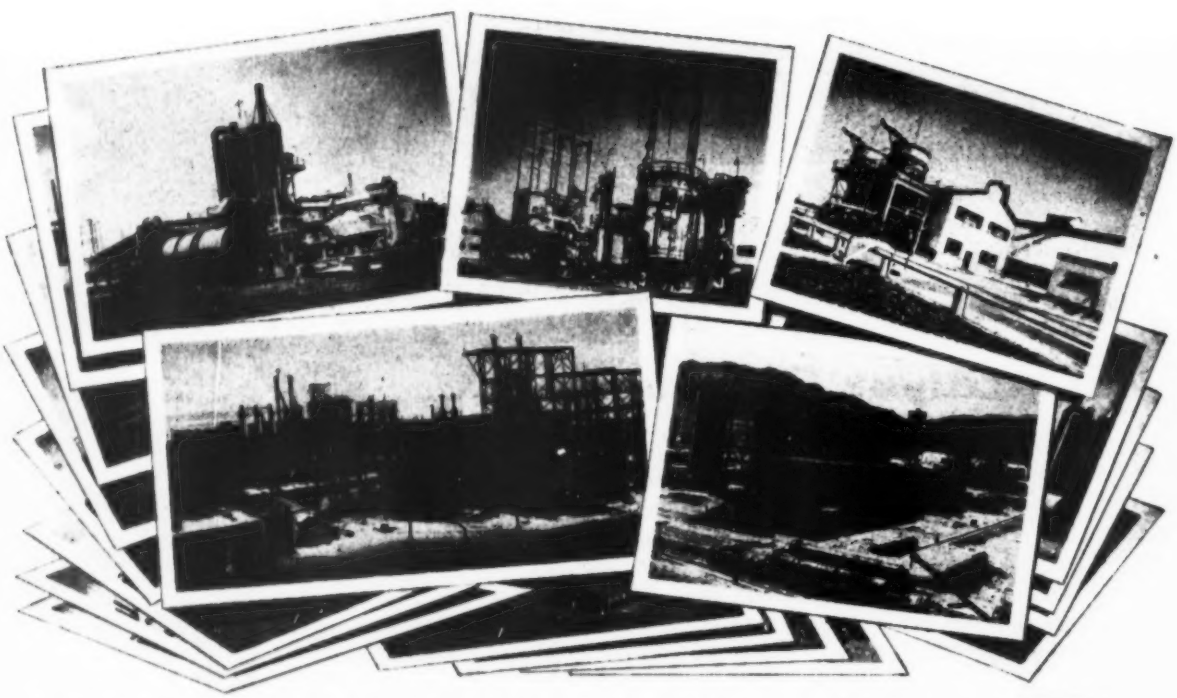
40th

Year of Service to the Chemical Industry

Generally, there's not much point in telling people how long you've been in business. But it so happens that the 40 years of Chemico's existence also marks the period of greatest growth of this country's huge chemical industry. Chemico is proud of its part in the development of this industry . . . a development that required more than a little pioneering courage.

They say that "Life begins at 40" because that age combines seasoned judgment with youthful vigor. At this 40th Anniversary Chemico certainly offers experience, initiative and the assurance that you can, as always, depend upon the promise in our slogan:

"Chemico plants are profitable investments"



CHEMICAL CONSTRUCTION CORPORATION

A UNIT OF AMERICAN CYANAMID COMPANY

488 MADISON AVENUE, NEW YORK 22, N. Y.

CABLES: CHEMICONST, NEW YORK

TECHNICAL REPRESENTATIVES: CYANAMID PRODUCTS LTD., LONDON • CHEMICAL CONSTRUCTION (INTER-AMERICAN) LTD., TORONTO • SOUTH AFRICAN CYANAMID (PTY) LTD., JOHANNESBURG

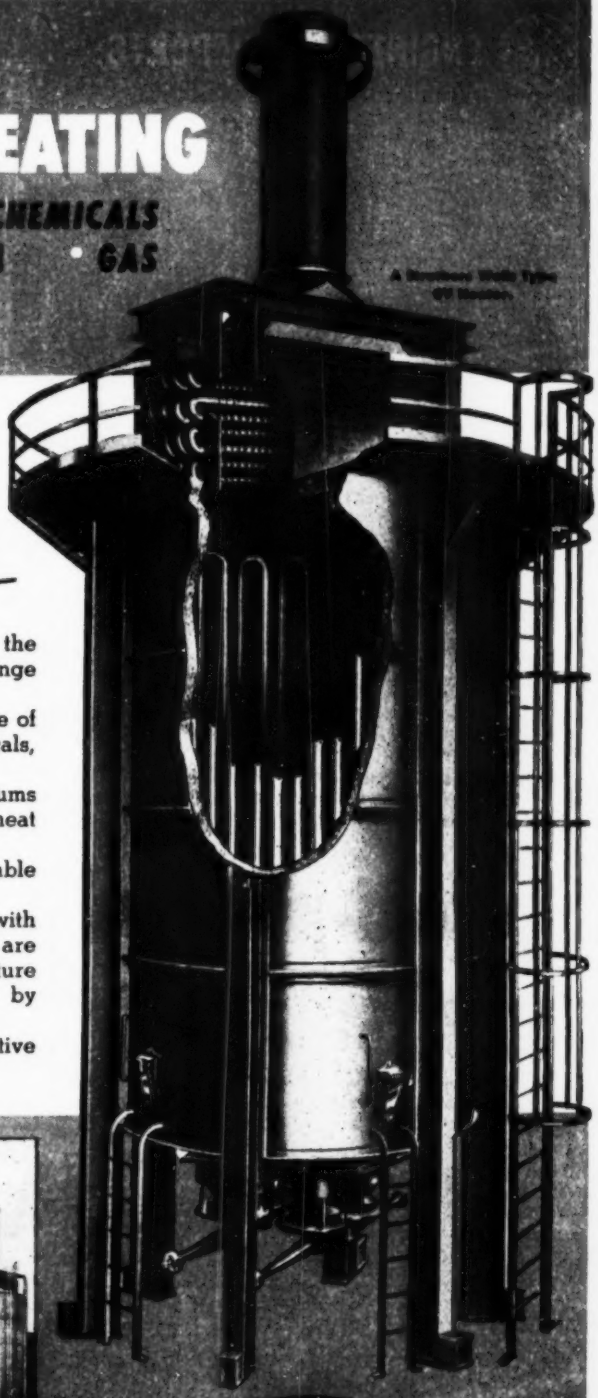
CHEMICO CHEMICAL CONSTRUCTION CORP.

CC-800

for HIGH TEMPERATURE HEATING

• PROCESS FLUIDS • ORGANIC CHEMICALS
• PETROLEUM OILS • STEAM • GAS

Struthers Wells



DEPENDABLE HEATING EQUIPMENT

Struthers Wells standard equipment is available for the direct or indirect heating of process fluids, in any range of commercial size or temperature requirement.

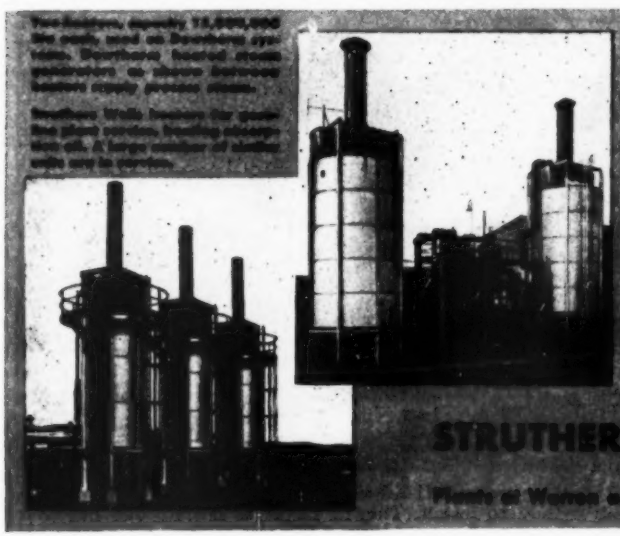
Direct fired heaters are used to heat a wide range of fluids, including petroleum oils, organic chemicals, steam superheating and gas heating.

Indirect heating systems utilizing circulating mediums as Dowtherm, salt or other fluids, are used to heat process vessels to elevated temperatures.

Electrically heated circulating systems are available in smaller sizes.

High thermal efficiencies may be secured with Struthers Wells fired heating system; complete units are supplied including safety devices and temperature control. Trouble-free operation has been proven by hundreds of installations.

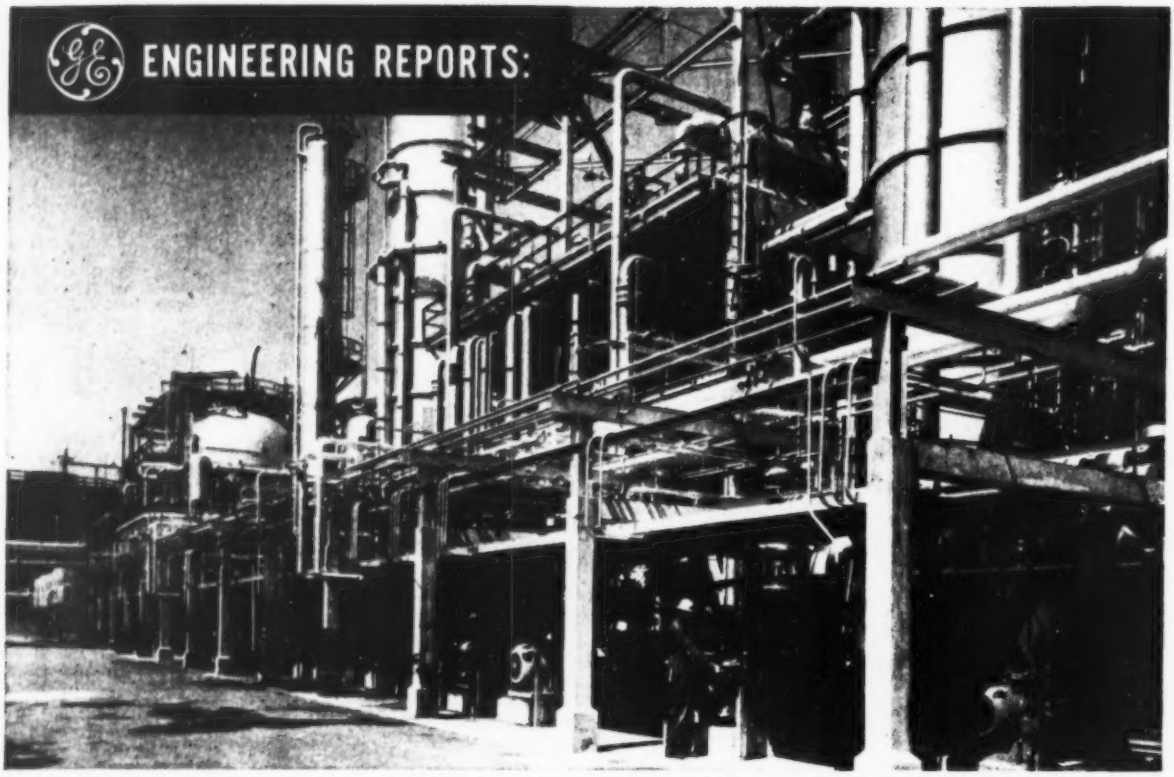
Our new Bulletin C-45 is available to prospective users on request; please write on your letterhead.



Struthers Wells

STRUTHERS WELLS CORPORATION
WARREN, PA.
Plants at Warren and Titusville, Pa. Offices in Principal Cities

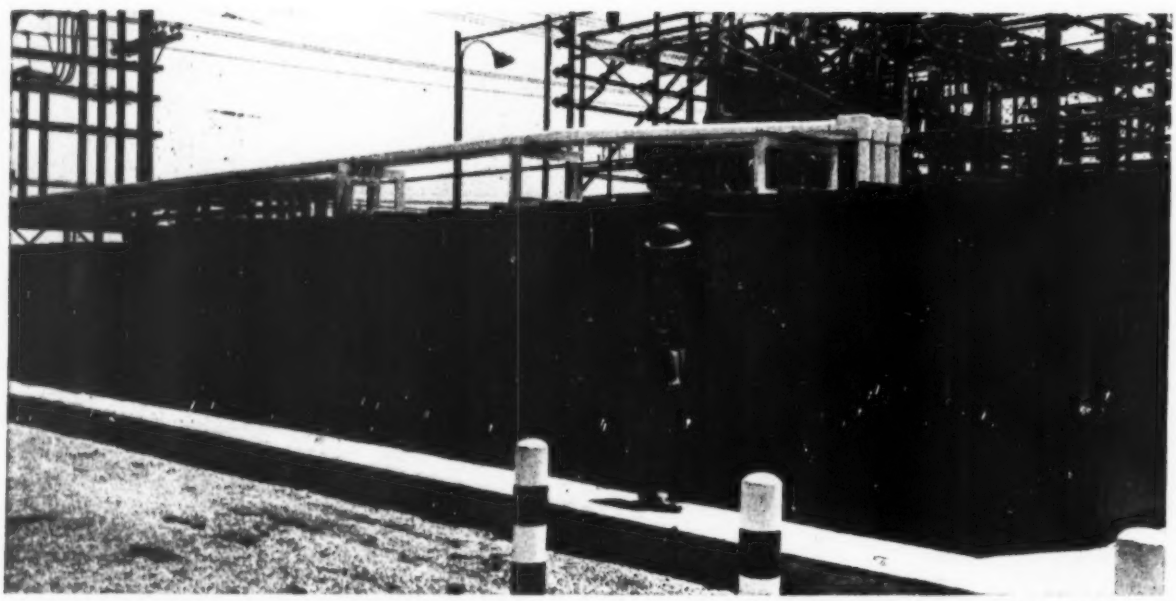
ENGINEERING REPORTS:



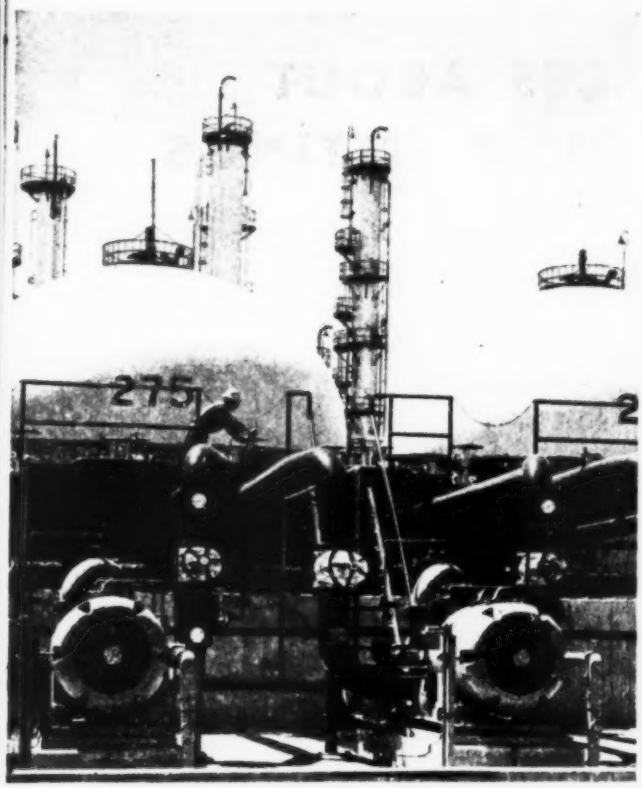
"WORK HORSE" LINEUP of totally-enclosed, fan-cooled Tri-Clad* motors under topping units meet rigid requirements for continuous processing and safety. Cast-iron frame construction helps protect punchings, windings, and rotating parts from dusts, moisture, and corrosive atmospheres. Each motor has a matching explosion-proof push-button station.

*Registered Trade-mark of General Electric Company

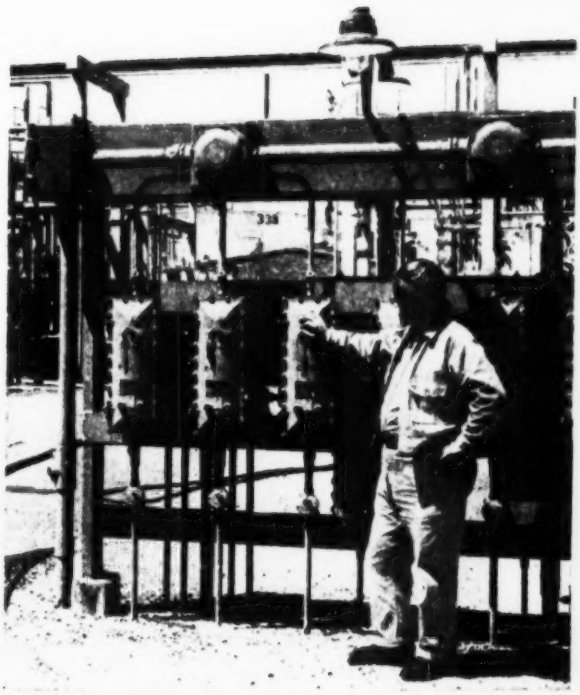
System-planned electric equipment



COMPACT, OUTDOOR METAL-CLAD SWITCHGEAR in foreground is the main distributing point of power to Union Oil's Wilmington refinery. Providing primary circuit protection, these compact G-E units are factory-assembled and shipped ready to install. They're simple to operate and maintain because of a fast, vertical-lift system of breaker removal

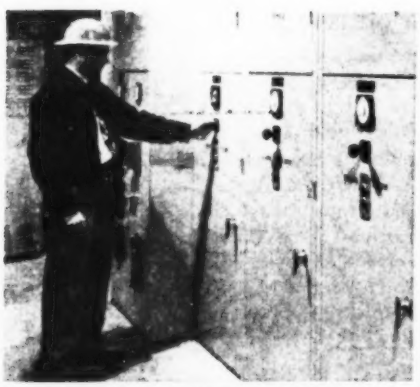


TOTALLY-ENCLOSED, CLASS 1 GROUP O G-E MOTORS are designed for corrosive and hazardous refinery locations like these two Tri Clad units driving transfer pumps.



EXPLOSION-PROOF motor starters have cast-alloy enclosures, helps protect against hazards. They are centralized on one rack for easy accessibility and a better distribution system.

helps keep throughput high at Union



CENTRALIZED G-E LIMITAMP CONTROL, located in a non-hazardous area, starts and protects motors driving refinery equipment.

Two new topping units at Union Oil's Wilmington refinery kept on-stream by G-E power and drive equipment

Recently, the Union Oil Company wound up a $27,000,000 expansion program at their Wilmington, Calif. refinery by putting two new 20,000 bbl.-per-day topping units and the nation's largest vacuum flasher into action.

To help maintain this output on a continuous basis, Union Oil and General Electric engineers co-ordinated all drive and power distribution equipment—"system-planned" it to the plant's specific processing needs.

G-E application engineers, experienced in refinery practices, are ready to assist you and your consultants in planning an efficient electrical system.

TO HELP CUT YOUR POWER DISTRIBUTION COSTS be sure to see the new full-color sound slidefilm, "The Vital Link." It's another G-E "More Power to America" program. Ask your G-E apparatus sales representative to arrange a showing. General Electric Company, Schenectady 5, New York. 661-42

Engineered Electrical Systems for Petroleum Refineries

GENERAL ELECTRIC

3 IMPORTANT FACTS ABOUT MIDWEST WELDING FITTINGS

Check 'em ✓

Midwest originated and developed the Long Tangent Elbow, the Reducing Elbow, Saddle, Sleeve, Shaped Nipple, and Lap Joint Stub End with large radius and heavy forged lap.

1 They are more ductile and have greater bursting strength than seamless pipe of comparable analysis.

2 They enable you to cut all pipe in exact accordance with designer's drawings. They are accurate and uniform.

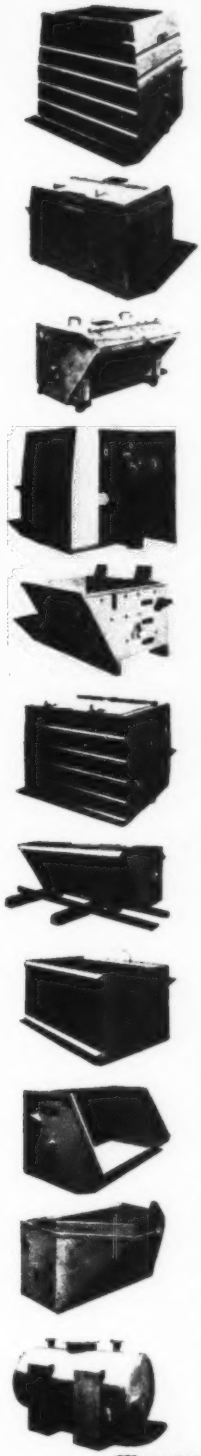
3 The line is complete and varied. It gives you greater latitude in design and permits improvements and economies impossible to attain otherwise.

J&L STEEL

JONES & LAUGHLIN STEEL CORPORATION
SUPPLY DIVISION

Serving The United States and Canada
General Offices: Tulsa, Oklahoma
J&L Tubular Products and Wire Rope

P·E·S·A
PARTNERS IN PETROLEUM PROGRESS

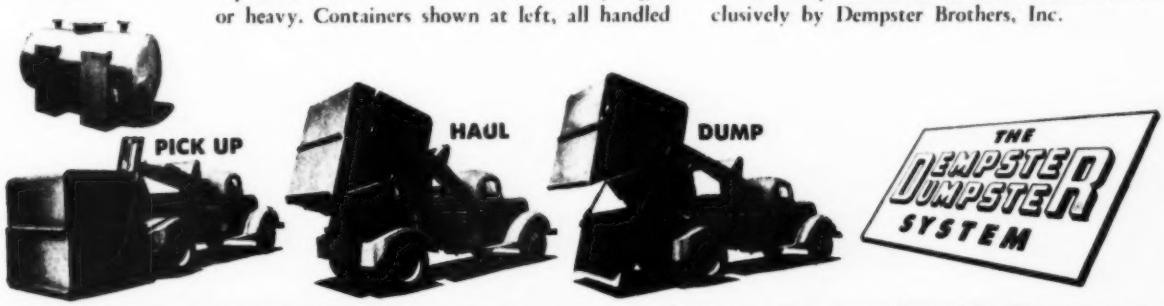


You will Dump High Costs, too..

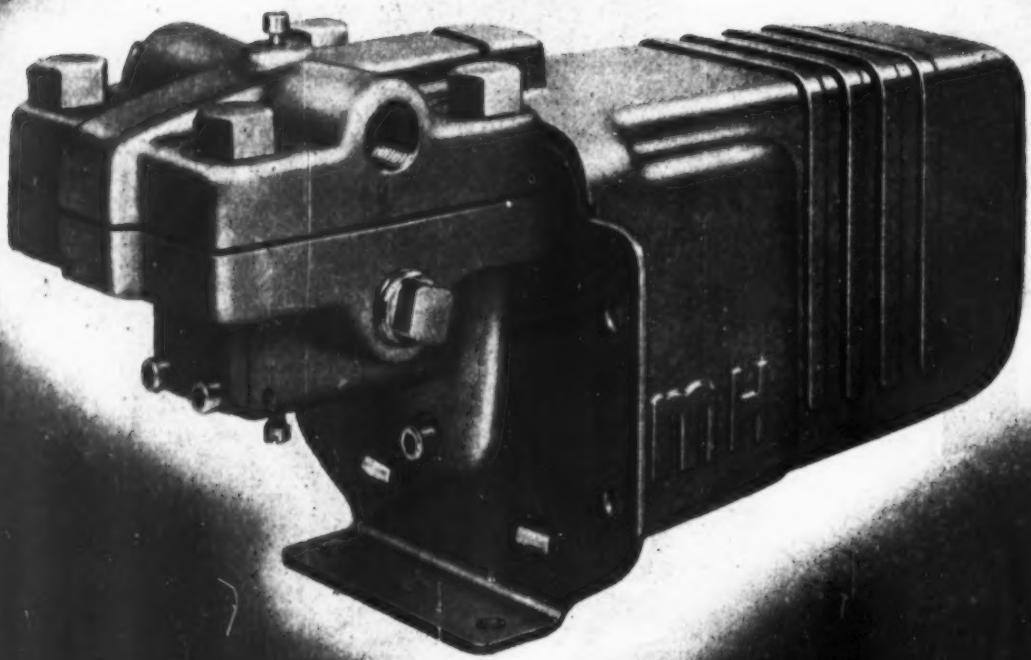
. . . when you install the Dempster-Dumpster System of Bulk Materials Handling

Manufacturers over the nation have learned to eliminate the costly and inefficient method of handling bulk materials with conventional dump trucks, drivers and loading crews. You can equip one truck with a hydraulically operated Dempster-Dumpster. Then, inside or outside buildings at convenient accumulation points, you simply place detachable Dempster-Dumpster Containers, in capacities up to 4 times that of conventional dump truck bodies, with each designed to suit the materials to be handled—be they solids, liquids or dust . . . hot or cold . . . bulky, light or heavy. Containers shown at left, all handled by one Dempster-Dumpster, are only a few of the many available or that can be built to meet your needs. The Dempster-Dumpster, operated by only one man, the driver, serves scores of containers . . . one after another, as shown below.

You eliminate trucks standing idle. You eliminate re-handling of materials. You eliminate loading crews. You increase efficiency, sanitation and good plantkeeping with this Dempster-Dumpster System—the lowest cost method of bulk materials handling ever devised. Write to us for complete information. Manufactured exclusively by Dempster Brothers, Inc.



DEMPSTER BROTHERS, 524 Dempster Bldg., Knoxville 17, Tennessee



compare these features!

simplicity:
uses no mercury; a rugged pneumatic balance transmitter, it has few moving parts . . . needs practically no maintenance.

wide range:
readily adjustable in the field for ranges from 0-20 to 0-200 inches of water.

simple calibration:
easily calibrated with weights . . . no curves or tables needed; 1 lb. equals 10" of water.

withstands overloads:
takes many times rated pressure without loss of accuracy or damage to working parts.

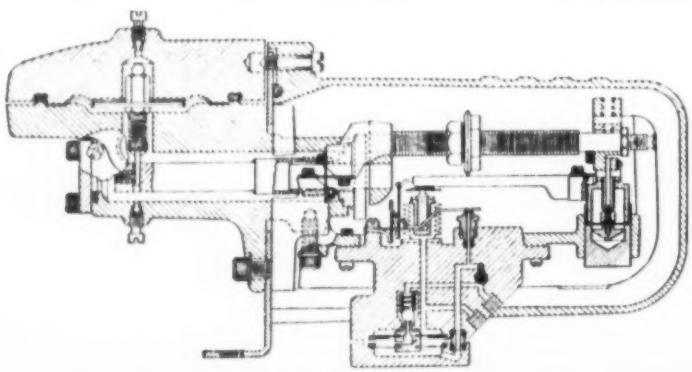
for use with miniature instruments:
converts pressure differential at the metering orifice into a proportional air pressure for transmission to remote indicators, recorders or controllers. The ideal companion for *Tel-O-Set* miniature instruments.

temperature range:
handles fluids at temperatures as high as 350° F.

versatility:
available with or without non-bleed pilot booster relay.

sensitivity:
responds rapidly to quick changes in flow.

easy installation:
lightweight, compact unit is readily mounted anywhere.



For flow measurements— the **HONEYWELL DIFFERENTIAL CONVERTER** *is better than ever*

NEW CONSTRUCTION features now make the Honeywell Differential Converter, more than ever, the standard of performance for remote measurements of flow and differential pressure.

It's more accurate than ever . . . has improved linearity of response. It's more stable, with a larger dashpot and heavier oil to smooth out spurious line fluctuations. And it's even more rugged . . . can take overloads of many times normal pressure without damage to the diaphragm or impairment of precision.

More than ten thousand Honeywell Differential Converters have been installed on an ever broadening variety of applications . . . on pipelines, in conjunction with graphic instrumentation, and in scores of other uses which need accurate, flexible remote transmission of measurements.

You can see what's behind this industry-wide acceptance, by checking the Differential Converter's outstanding features described on the opposite page. You can find out even more by testing it yourself, under any operating conditions your plant may present. And for a personal discussion of your individual process requirements, call your local Honeywell sales engineer . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Aves., Philadelphia 44, Pa.

● **REFERENCE DATA:** Write for new Bulletin 2290, "Honeywell Differential Converters."

MINNEAPOLIS **Honeywell**
BROWN INSTRUMENTS
First in Controls

How would YOU solve these two problems?

1. HE LIKES LIFE SAVERS because they're good. Life Savers Corporation had the problem of *exactly* determining candy moisture content — required 1°F temperature control — found this *accuracy* in Fenwal All-Purpose THERMOSWITCH® unit. Cost of control was low — results excellent.

2. PARAFFIN BATHS are important physical therapy equipment. For safety, temperature must be held within close limits. Makers of Dickson Paraffin Baths selected Fenwal THERMOSWITCH devices as entirely dependable and accurate in controlling heating unit.

3. A FENWAL THERMOSWITCH CONTROL may solve your problems, too. Its external, single-metal shell expands or contracts *instantly* with temperature changes, making or breaking enclosed electrical contacts. Compact, highly resistant to shock and vibration, Fenwal THERMOSWITCH units have solved hundreds of otherwise costly problems.

4. SEND FOR THIS NEW CATALOG for complete explanation of the unique THERMOSWITCH unit. Also ask for more detailed, illustrated discussions of the problems above. Fenwal engineers will be glad to help you solve your temperature control problems involving heat, humidity, radiant heat, pressure and other variables. **Write Fenwal Inc., 102 Pleasant Street, Ashland, Massachusetts.**

Fenwal

THERMOSWITCH®

Electric Temperature Control and Detection Devices

SENSITIVE... *but only to heat*

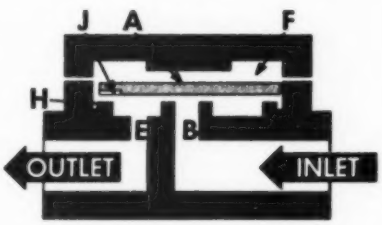
SARCO
Thermodynamic
STEAM TRAP

ACTUAL SIZE

this new trap virtually eliminates maintenance

SOLID STAINLESS STEEL DISC ACTS AS VALVE HEAD

HERE'S HOW IT WORKS!



Air and or condensate raise valve seat disc A, discharge thru E. When steam follows, greater velocity causes it to strike body at H thus building up pressure in chamber F. This causes disc to seat, closing tube B. As pressure in F decreases by condensation and leakage thru slot J, pressure in tube B raises disc and cycle is repeated.

The Sarco Thermodynamic Trap has proved successful on steam mains and separators; headers and soot blower pipes; engine and turbine stop valves, separators and casing drains; alternate heating and cooling applications.

A solid stainless steel disc—practically indestructible—is the only moving part!

MOST striking feature of the Sarco *Thermodynamic* Trap is its simple maintenance-free design. There's only one moving part – a solid stainless steel disc that practically lasts forever. There are no other moving parts to wear out or cause trouble.

Condensate, air and steam act directly on the disc valve which opens to discharge condensate and air – snaps shut to contain steam. There are no mechanical devices required to operate valve (see diagram at left). That means practically endless trouble-free operation.

Other advantages: small size, easy installation, not affected by shock or vibration, immunity to corrosive elements with all wearing parts stainless steel, same valve head and seat for all pressures to 600 psi and temperatures to 950° F.

Check these advantages to your own satisfaction at absolutely no cost. We'll send you a trap for free trial. All you do is fill out the coupon and mail it in.

SARCO COMPANY, Inc.
Empire State Building, New York 1, N. Y.

MAIL COUPON TODAY FOR FREE TRIAL

Sarco Company, Inc., Empire State Bldg., New York 1, N.Y.
Gentlemen: Please send me a Sarco Thermodynamic Trap for free trial, requirements as checked.
Size: ½"... ¾"... 1"... Operating Pressure:.....psi

For installation on.....

NAME _____

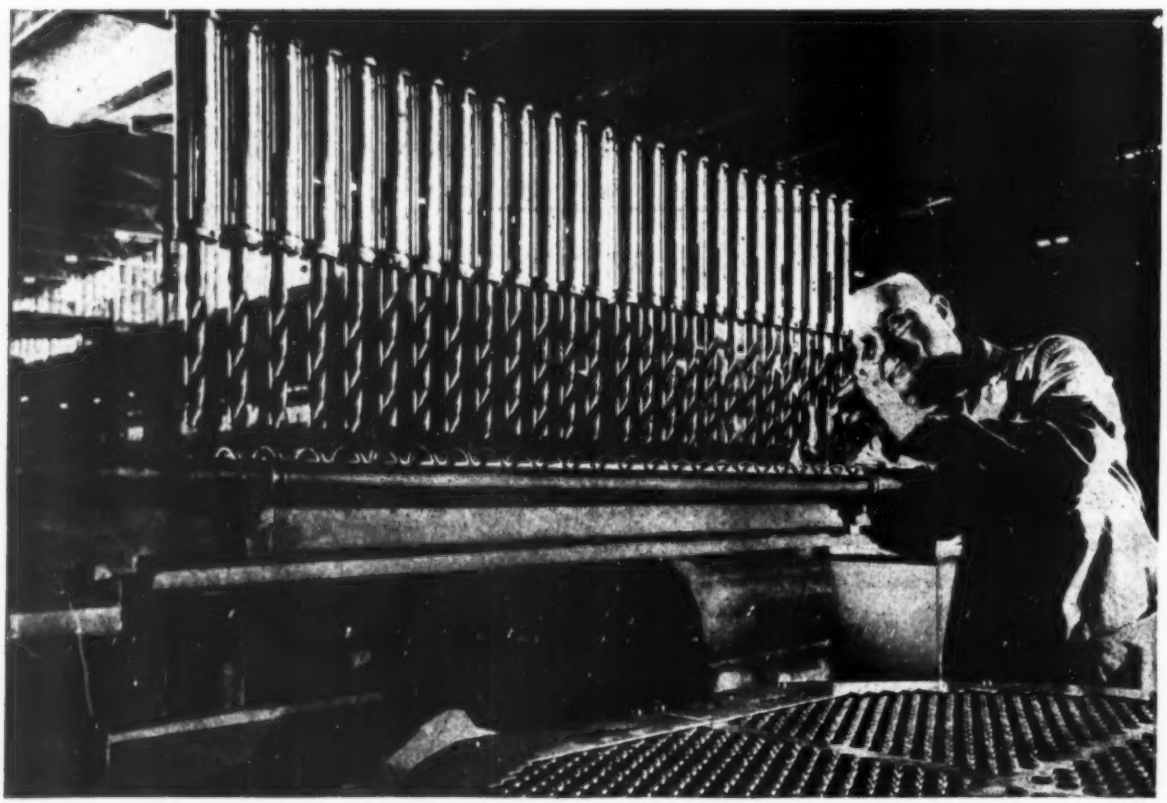
FIRM _____

ADDRESS _____

CITY _____ STATE _____

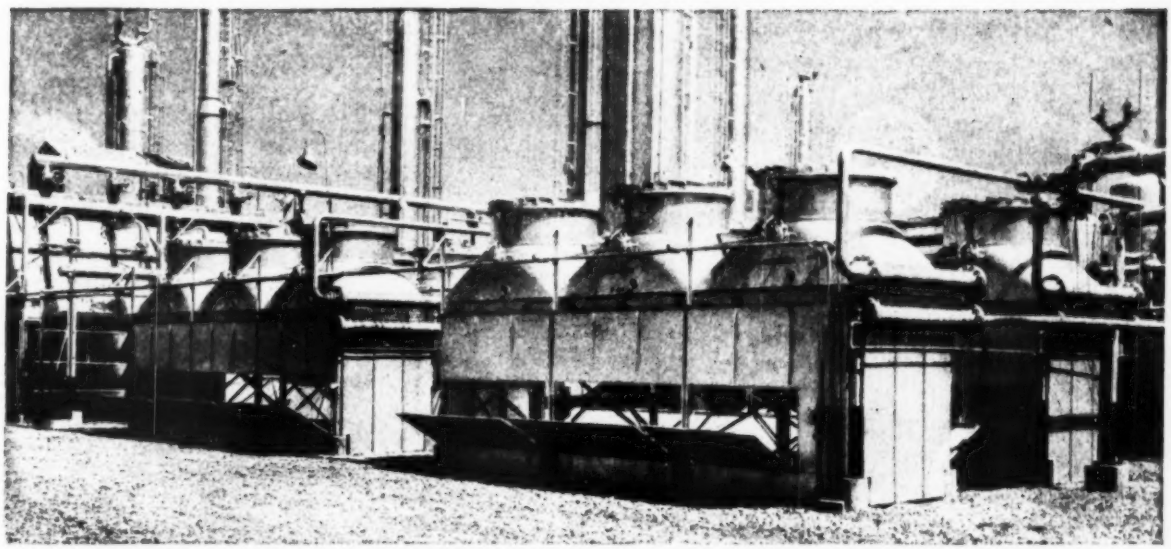
Profit-building answers to Modern

...examples of the wide variety of heavy-metal equipment designed and built by Alco to meet today's demands in petroleum and petrochemical processing . . . results of **Alco Experience** . . . gained through many years of designing and building heavy-metal equipment for refining and processing companies the world over . . . and **Alco Facilities** . . . capable of handling economically an extremely wide range of metal-fabricating operations . . . of meeting strictest customer specifications.

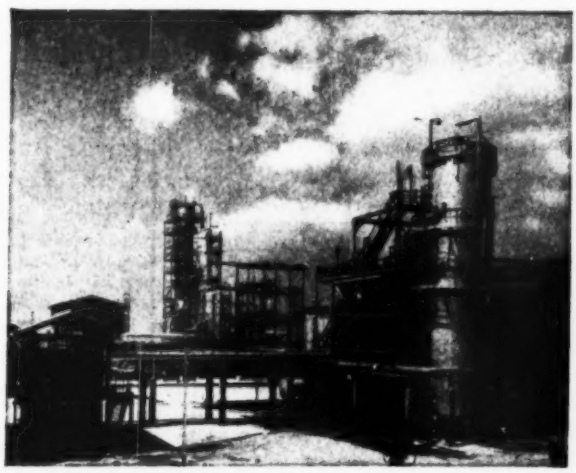


NEW 25 SPINDLE DRILLING MACHINE at Alco's Dunkirk plant typifies the special equipment that enables Alco to produce profit-building answers to almost any processing problem. Spindles take drills up to 1-in. in diameter, pierce steel tube-sheets and support plates up to 4-in. thick at optimum speed.

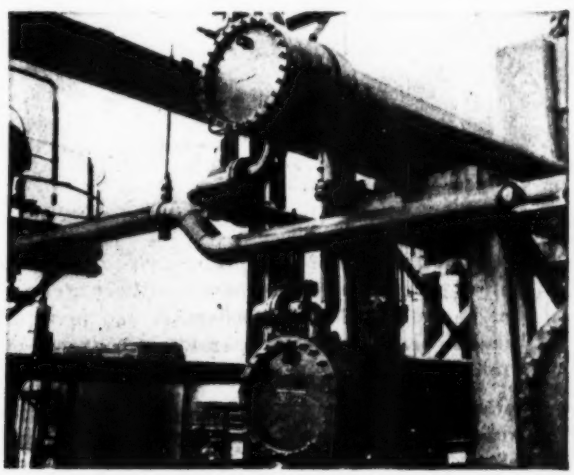
Processing problems



AIRCOOLERS solve the problem of efficient, economical heat dissipation in arid regions. Here, at a Wyoming gas plant, each of two batteries of two specially designed Alco units cools 125,500 lb per hr of lean solution (175 psi, 200 F) at a rate of 4,920,000 Btu per hr—a total of 251,000 lb and 9,840,000 Btu per hr.



AMONG THE MANY ALCO UNITS now in service at Shell Caribbean Petroleum Company's new refinery at Cardon, Venezuela, are the pressed oil flashtower and pressed oil stripper. With a daily capacity of 170,000 bbl, Cardon is the largest refinery on the South American continent.



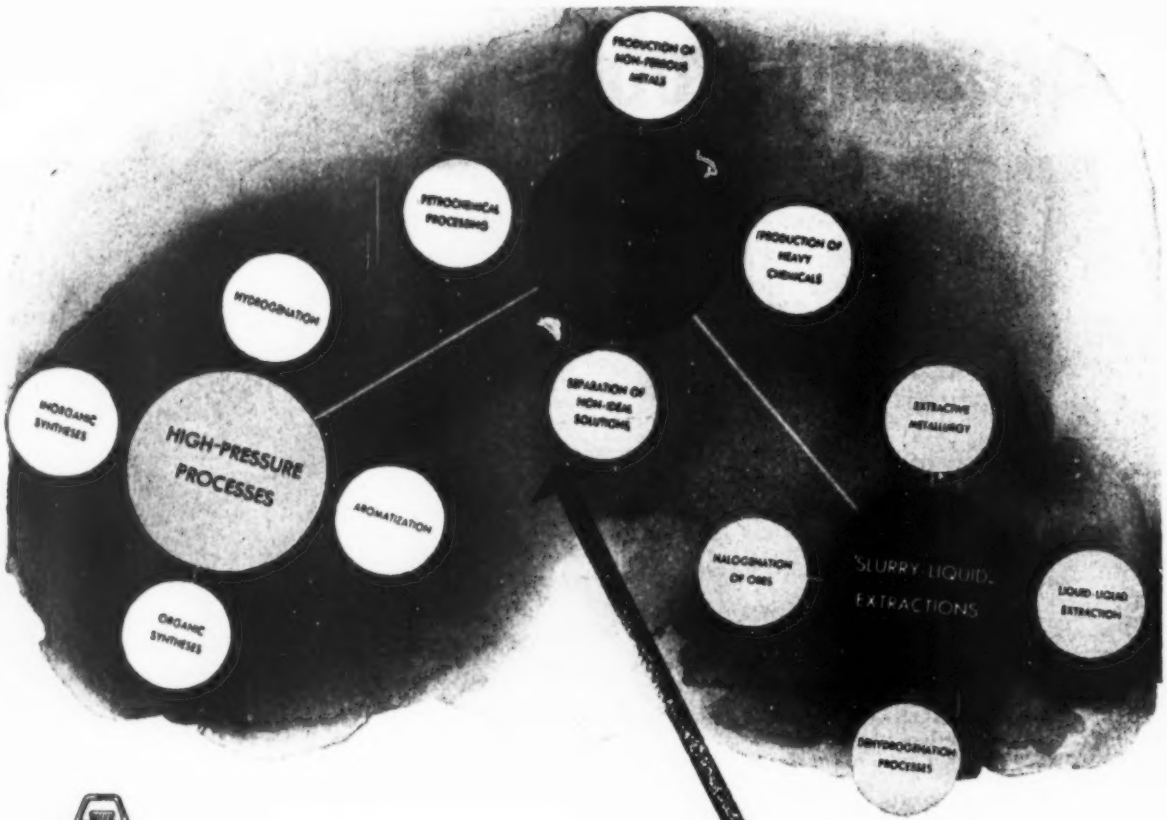
SPECIAL MONEL CONDENSERS, fabricated by Alco for Atlantic Refining Company's Philadelphia plant, boost efficiency in the manufacture of "Ultrawet" synthetic detergent. Monel construction guards against corrosion by the dilute hydrochloric acid produced in the vapors.

As the first step toward profit-building answers to your own processing problems, contact your nearest Alco Products Sales Representative today. Offices in Dunkirk, New York, Chicago, Los Angeles, Kansas City, Houston, Tulsa, and Beaumont.

ALCO

ALCO PRODUCTS DIVISION

AMERICAN LOCOMOTIVE COMPANY • DUNKIRK, N. Y.

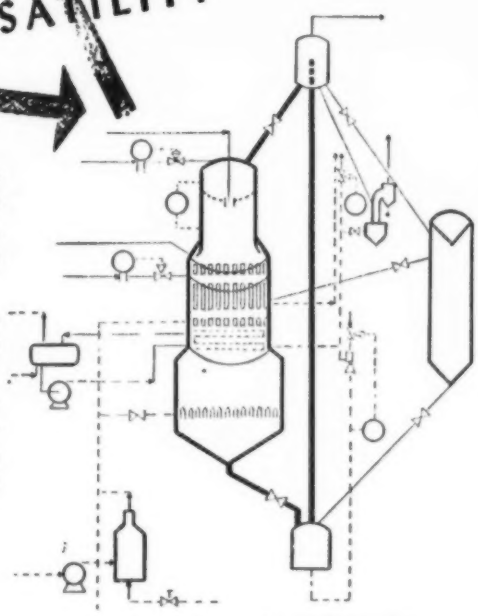


CATALYTIC CONSTRUCTION 100% ON TIME

BALANCE AND VERSATILITY

One important part of Catalytic's balance and versatility is a large staff of process engineers whose broad experience is available to you in the chemical, petrochemical and petroleum industries. They can serve you as an extension of your own personnel or as a total service.

Catalytic has been instrumental in the development of many new processing techniques for the chemical industries. Among other things, our wide experience in the field of the moving bed process may help you with its new and varied applications—a versatile modern method for carrying out chemical reactions or separations. After the process design is developed, Catalytic is equipped to carry out mechanical design and to deliver and construct a facility. We welcome your inquiries.



Commercial Houdriflow catalytic cracking unit

CATALYTIC

CONSTRUCTION COMPANY

1528 WALNUT STREET, PHILADELPHIA 2, PENNSYLVANIA

In Canada: Catalytic Construction of Canada, Limited: Sarnia, Ontario

CATALYTIC *ON-TIME . . . ON-BUDGET* SERVICES for the chemical, petrochemical and oil refining industries

Project Analysis · Process Design · Economic Studies · Engineering · Procurement · Construction · Plant Operation

QUENCHED NUT

The Bethlehem Quenched Nut is no ordinary nut, but is definitely superior in every way. It is made from 0.40 to 0.50 carbon steel, and is forged and extruded in a forming die, then quenched and tempered. This manufacturing procedure permits the nut to develop the full strength of any stud or bolt with which it may be used.

CONTINUOUS-THREAD STUD

Here's the big reason why the Bethlehem Continuous-Thread Stud resists premature fatigue failure—there's no point of thread run-out anywhere on the stud. Therefore severe stresses cannot hit at any one point. Instead, they are effectively distributed along the stud's working length. The stud is made from carbon or alloy steels, and comes plain or heat-treated.

Bolting Trio Resists Fatigue Failure..Minimizes Down-Time

The three fasteners shown above are ideal for operations involving high temperatures or high pressures, or both. This is because of the effective battle they put up against premature fatigue failure.

The trio, consisting of the Bethlehem Continuous-Thread Stud and two Bethlehem Quenched Nuts, have the ability to stay on the job for long periods of time. They minimize down-time, and thus effect worthwhile operating economies.

Both the Bethlehem Continuous-Thread Stud and the Quenched Nut are made in a range of sizes so wide as to meet virtually every need. If you'd like to discuss their use with a Bethlehem representative, drop a line to the nearest Bethlehem office.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

Wagner®
ELECTRIC MOTORS
...the choice of leaders in industry

Type JP, non-ventilated. Explosion-proof. ½ through 1½ hp.

Type JP, totally-enclosed fan-cooled. Explosion-proof. 2 to 250 hp.

for extra protection against corrosion

SPECIFY Wagner CAST IRON FRAME MOTORS

Here are stock motors specifically designed for use in chemical plants, oil fields, refineries, steel mills—for rugged industrial applications where dust, dirt, moisture, or corrosive vapors are present.

These motors are totally-enclosed in corrosion-resistant cast iron and all parts exposed to the atmosphere are of corrosion-resistant material—including the nameplate. They feature completely protected laminations . . . special varnish treated windings . . . and a running shaft seal.

Wagner Cast Iron Frame Motors are available in fan-cooled standard and explosion-proof types in ratings from 2 to 250 hp, and in non-ventilated standard and explosion-proof types in ratings from ½ through 1½ hp. Wagner Bulletin MU-132 gives complete information.

A skilled Wagner engineer can help you select a Wagner Motor to meet your most exacting specifications. Call the nearest of our 32 branch offices, or write us.

Wagner Electric Corporation
EST. 1891

WAGNER ELECTRIC CORPORATION
6450 PLYMOUTH AVE., ST. LOUIS 14, MO., U.S.A.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

ELECTRIC MOTORS
TRANSFORMERS
INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

Century APAC®

gives you more—much more—for your building dollars

In the picture above "Century" APAC in 3/8" thickness is being secured in steel channels for the ceiling. It is an all-purpose building material made in 4' x 8' sheets from asbestos fiber and portland cement. These practically indestructible materials give APAC many exceptional and desirable qualities.

It cannot burn, rot, or corrode. It is completely resistant to rain, sun, and temperature change. Vermin cannot damage it. Although it takes decorative colors well, you never have to give it a protective coat of paint.

It goes up fast, too! Workmen find the large sheets easy to handle. Special sizes or shapes can be cut on the job . . . no special skills or tools are required. And "Century" APAC has almost no limit to its usefulness: it serves for both exteriors and interiors, walls and ceilings.

Before you give the "go-ahead" on your company's next building project, find out if "Century" APAC couldn't do the job best and at lowest cost! See your K&M distributor for complete information, or write directly to us.

Nature made asbestos . . .
Keasbey & Mattison has made it serve mankind since 1873

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

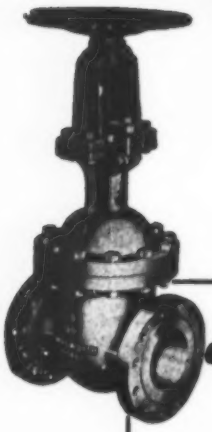
K&M Asbestos ®

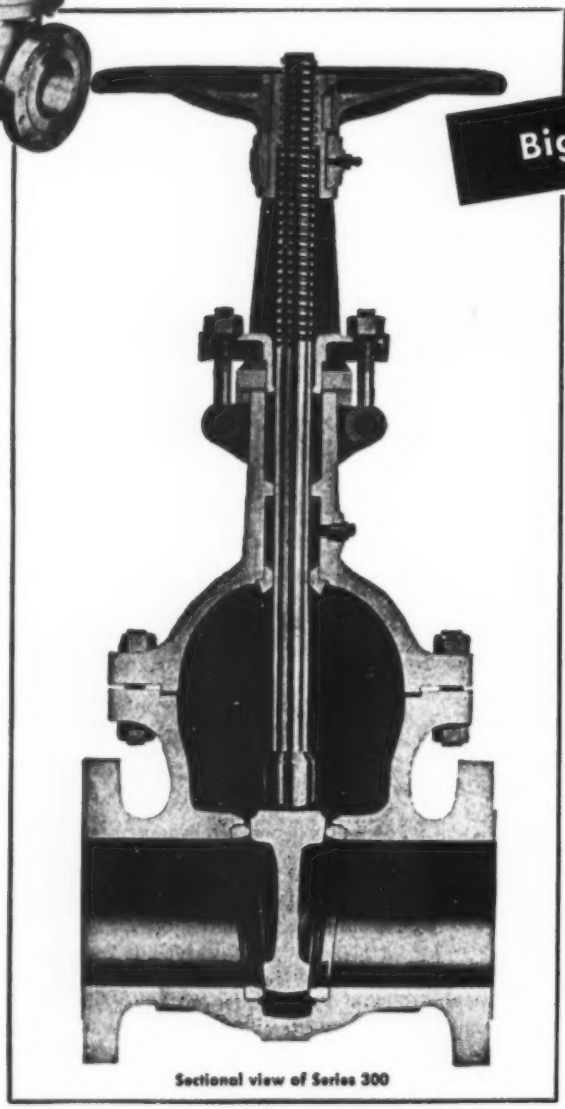
WALWORTH

Cast Steel Gate Valves

Series 150 and 300

Wedge Gate — Outside Screw and Yoke





Sectional view of Series 300

Big 8-Point Superiority!

Gland clearances are such that stem cannot be scored if gland should be tightened unevenly.

Deep Stuffing Boxes in all sizes (2″ to 24″) insure tightness and maximum packing life – costly leaks are eliminated.

Bonnets and Bodies are engineered to withstand pressure and minimize distortion – they're tough, durable, dependable.

Heavy Steel Walls provide extra strength and longer life.

Integral Body Guide Rib Faces are machined to insure accurate disc seating.

Seat Rings are bottom seated – not flange type. No recess exists at back of ring – hence no turbulence, erosion, or pressure drop.

Streamlined Ports allow high velocity, non-turbulent flow, and reduce the possibility of erosion.

Valves regularly have flanged ends. They can be supplied with ends for butt welding. Roller bearing yokes are available. On valves 5 inches and larger, by-passes can be furnished.

For Series 600 and higher, we recommend Walworth Pressure-Seal Steel Gate Valves.

For further information on Walworth Cast Steel Gate Valves, see your local Walworth distributor, or write:

WALWORTH

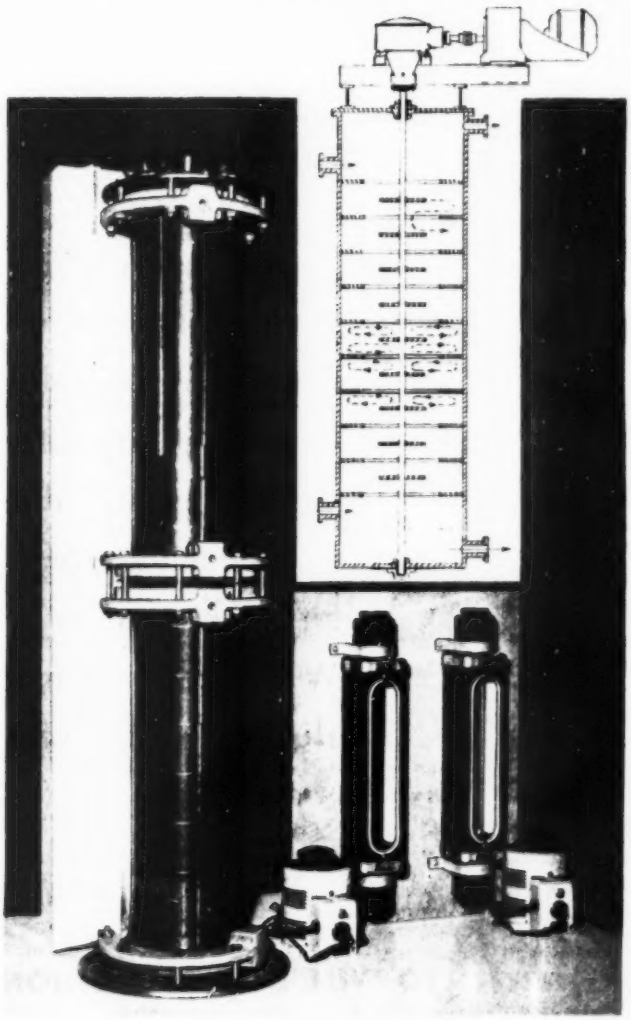
valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

TURBO-MIXER, a division of

GENERAL AMERICAN TRANSPORTATION CORPORATION



Demonstration model—used to show how the R.D.C column actually operates

Turbo-Mixer R.D.C.* Column

Rotary Disc Contactor for Liquid-Liquid Counter-current Extraction

Six years of data and design development in the laboratory, pilot plants and industry have demonstrated the superior features of this practical counter-current and gravity flow extractor. The R. D. C. extractor offers:

1. **high volumetric efficiency**
2. **high throughput capacity**
3. **simplicity of construction**
4. **no interstage or external settlers**
5. **low power requirements**
6. **flexibility of operation**

May we assist you in the solution of your extractor problems? Our laboratory facilities are available for evaluation of your extraction system.

**Licensed under Shell Development Company patent*

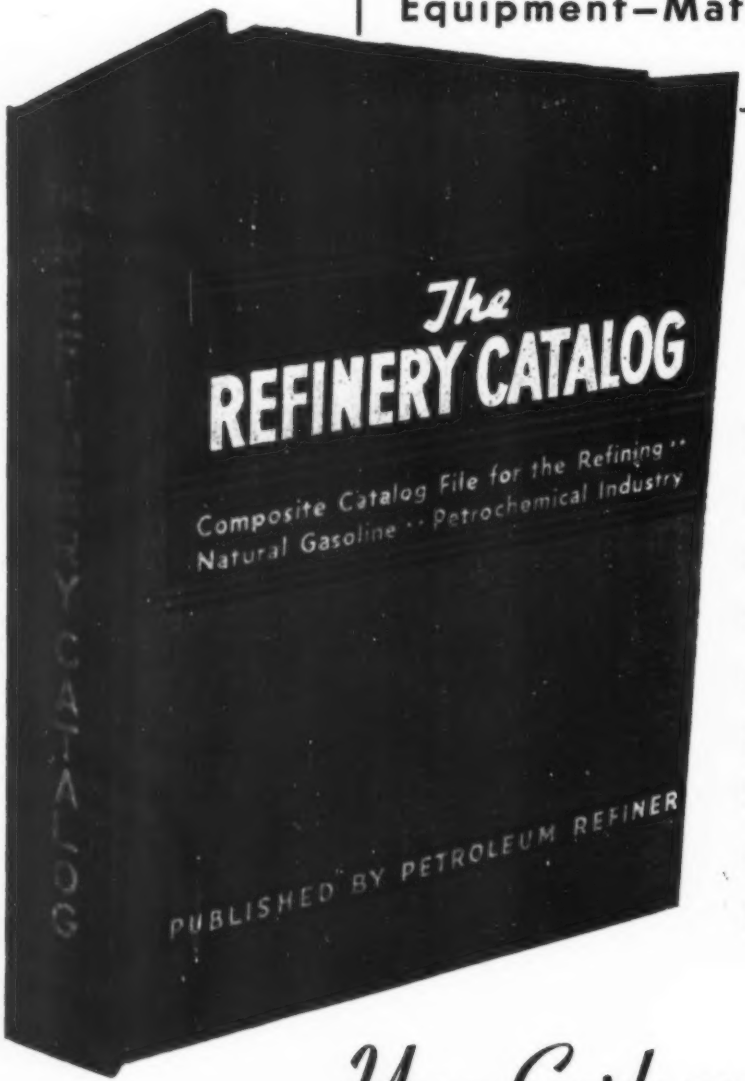
SALES OFFICE: 380 MADISON AVENUE, NEW YORK 17, NEW YORK

General Offices: 135 S. La Salle St., Chicago 90, Illinois • Offices in all principal cities

OTHER GENERAL AMERICAN EQUIPMENT:—DRYERS • EVAPORATORS
DEWATERERS • TOWERS • TANKS • PRESSURE VESSELS

Watch for this sign of Customer Service

BASIC SOURCE BOOK
for
REFINING INDUSTRY
Equipment–Materials–Processes


The
REFINERY CATALOG
Composite Catalog File for the Refining ·· Natural Gasoline ·· Petrochemical Industry
PUBLISHED BY PETROLEUM REFINER
THE REFINERY CATALOG

21st (1954) EDITION
Now Off the Press

Choose a product. You'll locate it easily, quickly in the Refinery Catalog. Hundreds of manufacturers have filed their catalogs in this equipment information guide. The NEW 21st Edition is more useful, more complete than ever.

Your Guide **TO WISE BUYING DECISIONS**

REFINERY CATALOG

THE UNIVERSAL EQUIPMENT GUIDE FOR REFINERY BUYERS

Published by Petroleum Refiner, P. O. Box 2608, Houston 1, Texas

Badger

Expansion JOINTS

LONG-LIFE FEATURE

COLD HEATING HOT

the ALL-CURVE, directed flexing, corrugation.*

LONG-LIFE FEATURE

PROPORTIONAL DEPTH of corrugation for each range of diameters and traverse.**

Badger Directed Flexing Self-Equalizing Expansion Joints give exceptionally long service life, proof of which has been well established in the City of New York where more than 4,000 of these Badger Joints are installed in the underground steam lines of the largest district heating company in the world.

*** The exclusive all-curve directed flexing corrugations and matching equalizing rings distribute the flexing stresses over the entire area of all corrugations.**

**** For each range of diameters there is a carefully calculated depth of corrugation with a defined limit of traverse.**

Each Badger Expansion Joint is originally designed with the proper number and depth of corrugations for maximum flexibility and service life at full rated traverse.

Remember — when you want long trouble free service in your distribution system, there is no substitute for the proper number and depth of corrugations. COMPARE BEFORE YOU BUY and to be sure you get the best, specify "BADGER".

BADGER MANUFACTURING COMPANY

Original and Sole Manufacturer of Badger Expansion Joints

230 BENT STREET • CAMBRIDGE • MASS.

THE engineers at National Tube have a big job to do. They're here to solve *your* tubing problems. They excel at their jobs, these engineers, because they are tubing specialists. What's more, they are backed-up by National's "experience file"—a collection of case histories dealing with practically every condition or combination of conditions in the book. These case histories are the result of 60 years' work on tubing problems, and contain the answers to just about every known type of refinery tubing service.

Through this long, varied experience National has improved pipe and tubing to such a degree that we are now able to offer you seamless tubing, condenser tubes, heat exchanger tubes, and refinery piping in a selected group of *24 different analyses*. Each of the 24 analyses has been performance-proved to meet the specific requirements of corrosion and oxidation for which it is recommended. Other chemical compositions are also available in tubular products and a wide variety of high temperature problems are presently under study.

Look over the list of analyses. Then get in touch with us. Our engineers will cooperate in getting the analysis that will insure you utmost efficiency coupled with the most economical performance. Write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa.

National Tube's 24 different steel tubing analyses:

Carbon	5 Cr, ½ Mo	27 Cr
Carbon, ½ Mo	5 Cr, ½ Mo, 1½ Si	18-8
½ Cr, ½ Mo	7 Cr, ½ Mo	18-8 Ti
1 Cr, ½ Mo	8 Cr, ½ Mo	18-8 Cb
1¼ Cr, ½ Mo	8 Cr, 1 Mo	18-8 Mo
2 Cr, ½ Mo	9 Cr, 1 Mo	25-20
2¼ Cr, 1 Mo	12 Cr	
2½ Cr, ½ Mo, ¾ Si	12 Cr, Al	
3 Cr, 1 Mo	17 Cr	

WALLS WITHOUT WELDS

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
(Tubing Specialties)

COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

U·S·S NATIONAL SEAMLESS PIPE AND TUBES

UNITED STATES STEEL

The Mail Box . . .

Manpower Requirements

Dear Editor:

Your article on the survey of Inspection Practices and Problems in the January, 1954 issue of PETROLEUM REFINER was very interesting.

I am associated with inspection work in one of the larger refineries in the Philadelphia area and therefore extremely interested in this subject.

Careful review of your article revealed one point on which I had some difficulty understanding. This is Table 1.

I would appreciate it very much if you would explain this table and if you would submit figures for manpower requirements for various crude capacities.

John W. Beaston, Jr.

Philadelphia, January 19

Due to a typographical error, the figures listed for small refineries are in error by one decimal place, and should have read as follows:

Office and clerical workers:	0.05
Graduate engineers:	0.04
Total in Department:	0.10

Thus, according to Table 1, the manpower requirements for the various sized refineries listed by Reader Beaston are:

	MANPOWER		
Crude Capacity	Clerical	Engineers	Total in Department
14,000	0.7	0.6	1.3
20,000	1.0	0.8	1.9
45,000	2.3	3.2	6.8
85,000	2.6	4.3	11.9
125,000	3.8	6.3	17.5
150,000	4.5	7.5	21.0

Inspiration AND Data

Dear Editor:

Congratulations on the Petrochemical Process Handbook section of the November, 1953, issue of the PETROLEUM REFINER which arrived just as I was preparing a test for my chemical engineering calculations class. Two of the flow sheets provided the inspiration (and data) for two test problems. And believe it or not, the data proved to be consistent! So, special thanks from a teacher for a fertile source of problems.

Frank A. Anderson, Chairman,
Chemistry and Chemical Engineering
University of Mississippi

Unkind Words Unsaid

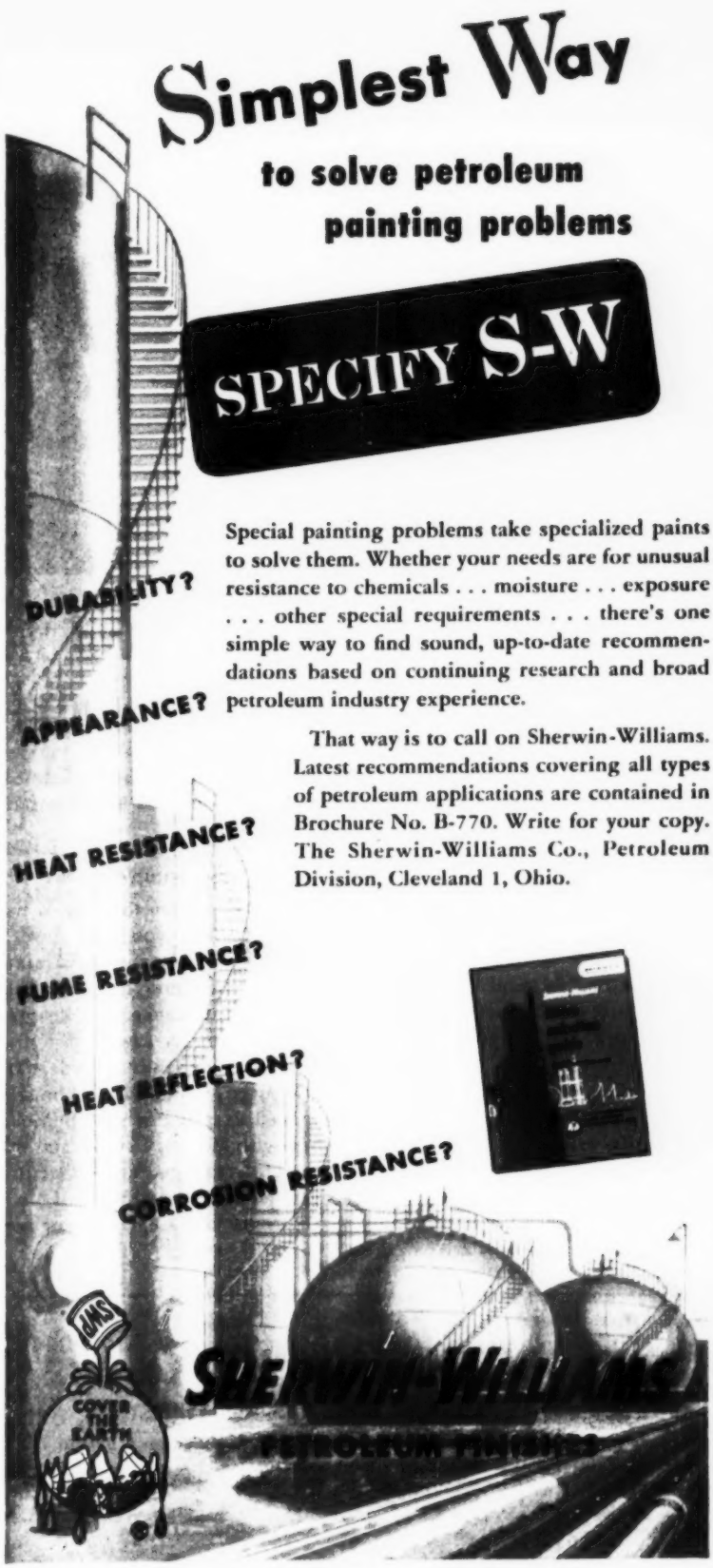
Dear Editor:

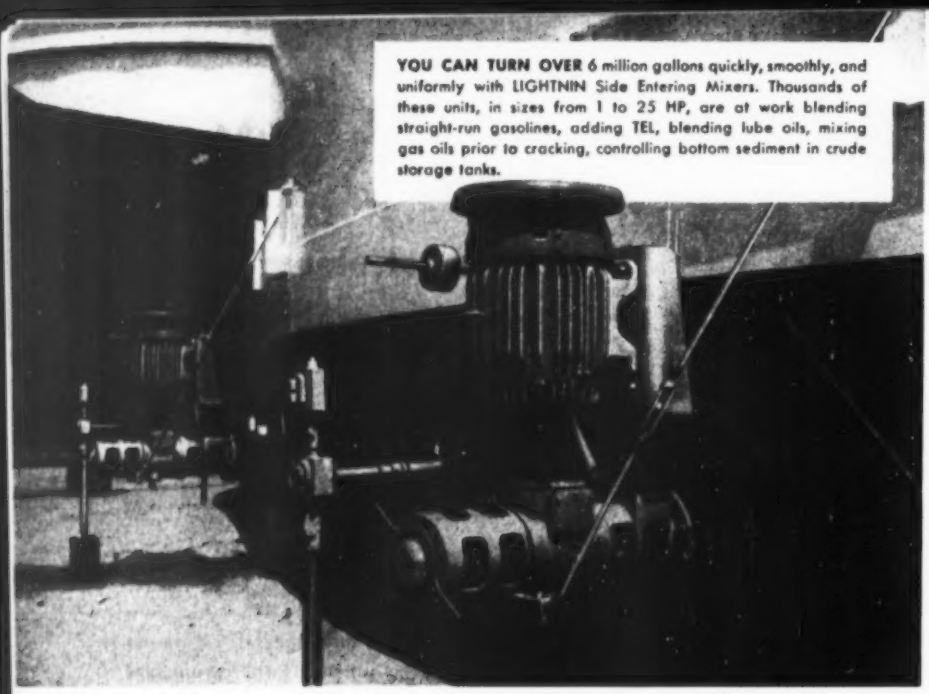
Kindly send me eight reprints of the Kenneth A. Kobe series (PETROLEUM REFINER, January, 1949-December, 1951) entitled "Thermochemistry for the Petrochemical Industry." Inclosed is $8.

The data contained therein have proved of valuable assistance to us in our graduate laboratory here at Montana State College, and the two copies that we have available are beginning to get rather dog-eared and worn. We have decided therefore that many unkind words about each other would not be said if each of us had our own copy.

Gordon R. Smith

Bozeman, Montana


Simplest Way
to solve petroleum painting problems
SPECIFY S-W
DURABILITY?
APPEARANCE?
HEAT RESISTANCE?
FUME RESISTANCE?
HEAT REFLECTION?
CORROSION RESISTANCE?
Special painting problems take specialized paints to solve them. Whether your needs are for unusual resistance to chemicals . . . moisture . . . exposure . . . other special requirements . . . there's one simple way to find sound, up-to-date recommendations based on continuing research and broad petroleum industry experience.
That way is to call on Sherwin-Williams. Latest recommendations covering all types of petroleum applications are contained in Brochure No. B-770. Write for your copy. The Sherwin-Williams Co., Petroleum Division, Cleveland 1, Ohio.
SMS
COVER THE EARTH



YOU CAN TURN OVER 6 million gallons quickly, smoothly, and uniformly with LIGHTNIN Side Entering Mixers. Thousands of these units, in sizes from 1 to 25 HP, are at work blending straight-run gasolines, adding TEL, blending lube oils, mixing gas oils prior to cracking, controlling bottom sediment in crude storage tanks.

How to be on safe ground when you plan for fluid mixing

A refinery engineer recently found he had been allowing two hours for a mixing operation that, when correctly done, took 15 minutes.

Why take chances with fluid mixing—when it's so easy to *be sure* you're right?

You can get the right data-answer for *any* fluid mixing problem—quickly, without cost or obligation—by handing the problem to your LIGHTNIN Mixer representative.

He eliminates guesswork and risk, by giving you an unqualified guarantee of *successful results.*

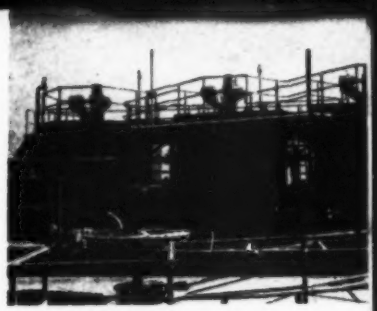
His approach to your problem is sound, fundamental—yet fully in step with today's processing methods.

His recommendations are based on 25 years of research and field experience on thousands and thousands of applications.

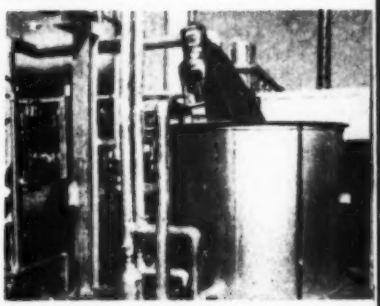
Save on upkeep, too

He can show you the way to maintenance savings you may never have thought possible with fluid mixers. A sensible program for reducing machine obsolescence, and keeping replacement costs low.

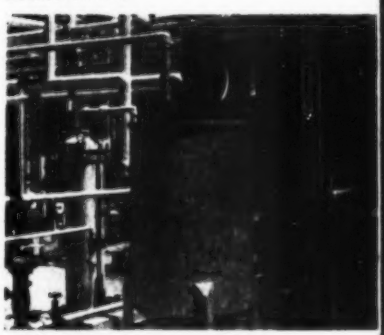
Before you select a fluid mixer for *any* purpose, find out how much time and effort you can save by checking first with MIXCO. Get the facts now on the LIGHTNIN guarantee that protects you unconditionally. Call in your LIGHTNIN representative—or write us today.



CAUSTIC TREATING and other mixing jobs become fast, efficient operation with turbine-type LIGHTNIN Mixers. You can mix, blend, suspend solids, get intimate gas-liquid and liquid-liquid contact, in open tanks or closed pressure vessels with these units. Standard sizes from 1 to 500 HP provide hundreds of power-speed combinations.



FOR TANKS up to 3,000 gals., continuous or batch mixing, pipeline mixing, there are 30 LIGHTNIN propeller-type models to choose from. Sizes ¼ to 3 HP.



OPEN TANK becomes an efficient mixing vessel when you add a LIGHTNIN Portable Mixer. Over 30 models, electric or air driven. Sizes ⅛ to 3 HP.

- ☐ DH-50 Laboratory Mixers
- ☐ DH-51 Explosionproof Laboratory Mixers
- ☐ B-102 Top Entering Mixer (turbine and paddle types)
- ☐ B-103 Top Entering Mixer (propeller type)
- ☐ B-104 Side Entering Mixers
- ☐ B-106 Condensed Catalog (complete line)
- ☐ B-107 Mixing Data Sheet
- ☐ B-108 Portable Mixers (electric and air driven)

MIXING EQUIPMENT Co., Inc.

164 Mt. Read Blvd., Rochester 11, N. Y.

In Canada: William & J. G. Greey, Ltd., Toronto 1, Ontario

Please send me, without obligation, catalogs checked at left.

Name ..... Title .....

Company .....

Address .....

City ..... Zone ..... State .....

Lightnin® Mixers™

GET THESE HELPFUL FACTS ON MIXING

LIGHTNIN Catalogs contain practical data on impeller selection; sizing; best type of vessel; installation and operating hints; full description of LIGHTNIN Mixers. Yours without obligation. Check and mail coupon today.

MIXCO fluid mixing specialists

The LOOK BOX for February . . .

Spending The Dollar

HAVE YOU ever wondered how a company goes about deciding the best way to spend its capital funds! An insight into how one company does this was given recently by Horace G. Hill of The Atlantic Refining Company before the American Management Association's annual finance conference. According to Hill, a series of three steps is necessary to make the decision:

First, there is the long range forecast—normally covering five years. Before it can carry any weight, it must have the approval of line executives, staff departments and financial management. Each of these departments pins down some of the phases of the forecast.

Second, the current budget must be prepared. The procedure is much the same as for the long range forecast. Staff departments contribute isolated projects and specific questions; operating management submits more detailed projects in such form that they can be checked by their monthly performance; financial management makes the decision on the tentative plan. Adjustments reconcile all viewpoints.

Third, the semi-performance report on projects that have been operating for a few years is considered. Here, performance is checked against past forecasts. Is the operation doing as well as expected? What effect will changing conditions and markets have on its future? Should additional capital funds be channeled into this operation? These are the questions that must be answered.

Careful consideration of how capital funds are spent may mean the difference between progressing, standing still or sliding back.

An Editor's Revelation

SOMETIME AGO, the staff of PETROLEUM REFINER wrote a small booklet entitled "How PETROLEUM REFINER articles Are Selected and Should Be Written."

From the numerous requests received for this booklet, we know that it is being used. It is probably being used more as an aid in technical writing than in telling our readers just how the articles in the REFINER are chosen.

Believe us, they are not simply taken "over the transom," nor are they simply the "pearls" cast at the conventions, congresses, and other technical meetings (not that there are not some darn hot papers at these get-togethers). Rather, they are the results of a lot of work (both pen and foot) on the part of both our authors and of our staff.

Why not pick up the little booklet and look in the front? We think you'd be interested in what you will find there. If you don't have a copy, write us.

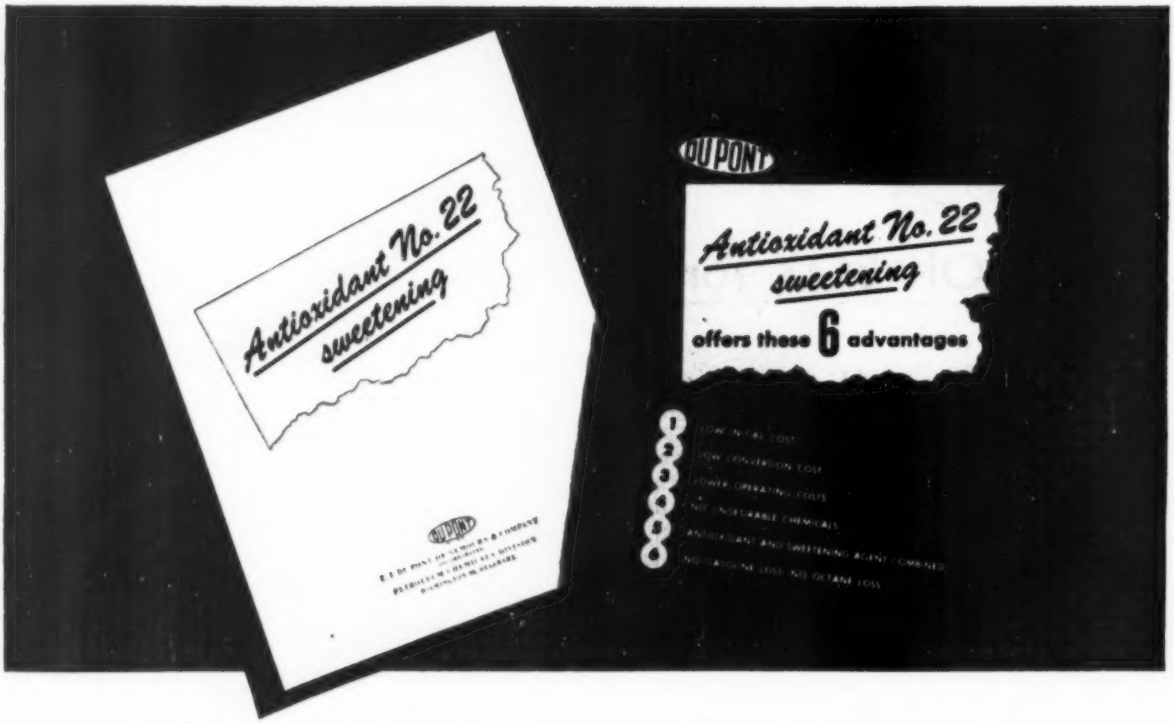
Natural Gas Good News?

THE NATURAL GAS industry received a pleasant surprise when the Supreme Court agreed to define how much jurisdiction the FPC had over natural gas. Under an earlier affirmation of a Circuit Court of Appeals ruling this country's natural gas producers were faced with government price regulations. The consequence of such regulations are bad and ill-advised when viewed from the long range point of view of both consumers and producers.

The earlier decision was that under the Natural Gas Act the Federal Power Commission has jurisdiction over gas sold to interstate gas transmission companies for resale (State of Wisconsin vs FPC. Nov. 30, 1953, in the so-called Phillips Petroleum Company case). Thus, it would appear, the FPC was obliged to regulate the field price received by the producers.

Future gas supplies would be imperiled by government control of field prices. Control of field prices would destroy the incentives to find and develop new gas reserves. Natural gas production cannot be regulated on a utility basis. Public utilities are protected against competition by franchises or certificates of convenience. Not so with the natural gas companies; theirs is a highly competitive business, the risks are great and there is no assurance of investment returns.

We recommend you read "Natural Gas for the Future" by Hines H. Baker, president of the Humble Oil & Refining Company. We have not seen a better discussion on government regulation and artificial control.



What you will want to know about the ANTIOXIDANT SWEETENING PROCESS

Since antioxidant sweetening offers many advantages, the chances are that you are looking for all the available technical information on the subject.

In answer to a number of requests, Du Pont has prepared a comprehensive booklet on antioxidant sweetening. It contains more information on this subject than ever before published in one volume.

Economy Features—The booklet presents information on how you may reduce your treating plant operating and equipment costs through Du Pont Antioxidant No. 22 as a sweetening agent. It also shows how you may eliminate loss in gasoline or octane number through the use of the process . . . as well as sweeten *and* inhibit your product in a single step.

The booklet also gives many helpful hints on controlling the operational variables involved and on getting best results without adverse effects on your product.

In addition, a briefer, 4-page folder outlining the advantages of antioxidant sweetening is also available from Du Pont.

Your Copies of the above booklets can be obtained from any of the Du Pont Petroleum Chemicals Division regional offices listed below.

DU PONT
REG. U.S. PAT. OFF.

Better Things for Better Living
. . . through Chemistry

Petroleum Chemicals

E. I. DU PONT DE NEMOURS & COMPANY (INC.)
Petroleum Chemicals Division • Wilmington 98, Delaware

Regional Offices:
NEW YORK, N. Y.—1270 Ave. of the Americas . . Phone COlumbus 5-3620
CHICAGO, ILL.—8 So. Michigan Blvd. . . . . Phone RAndolph 6-8630
TULSA, OKLA.—1811 So. Baltimore Avenue . . . . . Phone Tulsa 5-5578
HOUSTON, TEXAS—705 Bank of Commerce Bldg. . . . Phone PReston 2857
LOS ANGELES, CALIF.—612 So. Flower St. . . . . Phone MAdison 1691

IN CANADA: Canadian Industries Limited—Toronto, Ont.—Montreal, Que.—Calgary, Alta.
OTHER COUNTRIES: Petroleum Chemicals Export—Nemours Bldg., 6539—Wilmington 98, Del.

Gasoline the Critical Item

CONSIDERABLE improvement occurred recently in heating oil stocks which left gasoline as the principal disturbance to the industry's economic position.

Recent cold weather reduced much of the excessive quantities of distillate fuel oil previously held in storage. If cold weather continues the next two months, the fuel oil situation will show further improvement. On January 16, distillate inventories totaled 99⅔ million barrels, 11 million barrels higher than a year ago. However, just a month ago they had been 17 million barrels higher than they had been a year earlier.

Some slight upward adjustments in distillate fuel prices during January were highly encourging, although the advances were not sufficient to cover earlier price shading.

Supplies of gasoline are rapidly becoming excessive and are beginning to exert downward pressure on prices. Lower prices already have been the result in some areas. Any further substantial additions to inventories could easily and quickly result in widespread reductions, which would do damage to the industry's economic position.

At Mid-January, U. S. motor fuel inventories totaled 165½ million barrels, highest level in history, being even greater than the peak of 163 million barrels reached in March, 1953. Gasoline will continue to accumulate in storage until the end of March, when the heavy demand season will normally begin. Unless the rate at which gasoline is being put into tanks is sharply reduced during February and March, stocks will certainly be boosted to burdensome levels.

In the face of this darkened outlook, the refining industry has continued to produce nearly 3½ million barrels of gasoline daily, or near record levels. February will prove to be a critical period, as consumption will drop to the year's lowest level.

More Than Just a Stake

TAX BILLS for transportation will rise before long and it is urgent that taxpayers in all brackets, especially the petroleum industry, have a sound understanding of the nation's vital transportation needs. Recent reports point out that America hasn't been up to date in its road work since 1936, when it used public works to relieve an acute depression. Meanwhile, car and truck registration has risen by nearly 27 million. Before the war it was estimated that there would be 44 million vehicles on the road by 1960. But the figure has already reached 55 million. A rise to 80 million is predicted during the next 25 years.

An adequate highway network for this vast number of cars calls for an expenditure variously estimated at thirty billion dollars to over one hundred billions. Will a big investment in improved transportation facilities pay off? The answer lies in the fact that one out of seven persons employed in the U. S. has a job in the field of highway transportation. In retail trade, one out of every five dollars goes for some automotive product or service. Add to this picture the defense angle and there's a pretty convincing case for a concerted drive on this problem.

14 Reasons For Optimism

AMONG THE INDUSTRIALISTS who think there is little basis for talk of an impending recession is Paul G. Hoffman, chairman of the board of Studebaker Corporation. In an article in the New York Times Magazine he cites the following as "14 positive facts":

1. The average income of the American wage earner is at its highest peak.

2. Employment is at an all-time high of 63 million.

3. Individuals have been saving 8 percent of their after-tax incomes since 1950, compared with 5 percent in 1940.

4. Banks are averaging 50 percent of their deposits in loans as compared with 25 percent in 1940.

5. Scheduled tax reductions are expected to provide individuals and corporations with $3.3 billion in additional "spending money."

6. Unemployment compensation and similar economic "props and supports" have been enormously increased.

7. U. S. productivity is roughly equal to the combined output of all of the rest of the peoples of the world.

8. Industrial horizons are still expanding at a remarkable rate.

9. So-called basic industries are continuing to maintain strong foundations under the economy.

10. Governmental spending will likely reach $70 billion in the coming year.

11. Local, state and federal governments will have to apply themselves to a great backlog of necessary public works in the years immediately ahead.

12. The speculative excesses that have preceded, and to many minds have largely precipitated, the depressions of the past, are absent.

13. American population increases, discounting war, are anticipated averaging 2.7 million new consumers annually.

14. "Guarantee" factors, such as mortgage stabilization and secured bank deposits, make recurrence of some past evils unlikely if not impossible.

Are You Paying Too Much Income Tax?

Perhaps, unless you are familiar with recent developments. Here are some important ones.

• If the purpose of joining a club is to secure business or clients, at least a percentage of such dues and expenses are deductible, the courts have ruled recently.

A. E. AIKMAN, Magnolia Petroleum Company, Dallas

INCREASED FEDERAL income tax rates have led taxpayers into a closer acquaintanceship with allowable deductions to minimize their taxes. And that has resulted in some interesting developments and, perhaps, expansions in the field of income tax deductions.

The Internal Revenue Code provides that all ordinary and necessary expenses incurred in carrying on a trade or business are deductible, including salaries, rent and traveling expenses while away from home,[1] but some recent significant developments are of especial interest.

Instruction Costs. Ordinarily, education costs are not deductible as business expenses, but there are significant exceptions. In one case, a lawyer attended a taxation institute away from home and deducted as a business expense tuition fee, traveling expenses and cost of board and room while away. The deduction was upheld on the ground that this "was a way well adapted to fulfill his professional duty to keep sharp the tools he actually used in his going trade or business."[2]

The cost of attending summer school has been held a deductible business expense where it was necessary for taxpayer to do so in order to maintain her teaching certificate.[3] One recent case held that cost of additional instructions in library science was a properly deductible business expense by a librarian.[4]

Entertainment Expense. Such expenses are generally deductible as business expenses if incurred in efforts to acquire business. An employe properly may claim such deductions where he is expected by his employer to entertain at his own expense. The individual taxpayer deducts such expenses from gross income to compute his adjusted gross income.

A recent Tax Court decision has indicated that an individual taxpayer who stands the entertainment expenses may deduct, as regards his own meals, only that portion of the cost of his meal which exceeds that which he would normally pay.[5] The entire cost of the meals of those entertained is fully deductible. If company or employer pays the entire entertainment expense, then there is a full deduction by the company or employer.

Social Club Expenses. Earlier, the government took the position that social club dues and expenses paid by individuals were categorically nondeductible as business expenses. However, recently the courts have allowed at least a percentage of such dues and expenses as deductions if purpose of joining the club and incurring the expenses was to secure business or clients.[6] If the employer pays such dues and expenses for the employe, such items generally are fully deductible by the employer.

Employe Benefits. Salaries and wages paid to employes are, of course, ordinary and necessary business expenses deductible by the employer. However, employer-provided benefits other than salaries and wages may be deductible.

For instance, the employer may deduct as a business expense amounts contributed to employes for rehabilitation where damage and injuries were incurred by employes and their families in a tornado.[12] Moreover, such payments to employes do not constitute earnings and need not be reported as income by the employes.

An employer also may deduct as a business expense the cost of purchasing, renovating and improving a recreation lodge which it conveyed to its foreman's association for use by all employes.[13]

These types of expenditures are considered ordinary and necessary business expenses incurred by the employer to help maintain and im-

• **An individual who stands business entertainment expenses may deduct only that portion of the cost exceeding what he would normally pay for his own meals.**

• **Traveling expenses have been allowed only for overnight business trips. But recent decisions have held that an overnight stay isn't necessary to make such expenses deductible.**

prove employe welfare and morale and, therefore, essential to proper functioning of a business enterprise.

Travel Expenses. Internal Revenue Service has allowed travel expenses while away from home on business only in instances *where the taxpayer is away overnight*. It may be that this rule will be relaxed to some extent, since two recent decisions[14] have held that an overnight stay is not necessary to make such expenses deductible.

Depreciation Deductions. Recently, Internal Revenue Service announced its policy with reference to depreciation deductions.[15] As of May 12, 1953, the personnel of the Revenue Service are instructed generally not to disturb depreciation deductions as claimed by taxpayers except "where there is a clear and convincing basis for a change." This policy is to apply to all years open under the statute of limitation.

In following this policy, employes of the Service are to consider facts and arguments presented by the taxpayer with respect to obsolescence, as well as to repair and maintenance policy of the taxpayer. Adherence to this policy by the IRS should prove helpful since the method and rate of depreciation is admittedly a tough problem and often one which is based on facts peculiar to a particular taxpayer.

Other Developments. Included in the types of expenditures held to be business deductions are: payment of a penalty to the holder of a mortgage in order to secure a release of a mortgage on business property[16] and loss incurred on purchase and sale of government bonds where taxpayer was required to pledge such bonds as a guarantee of performance of a contract.[17]

Development Expenditures. As a complement to the above mentioned deduction, the Revenue Act of 1951 also permits a taxpayer to deduct or defer any expenditures incurred for the development of mines or other mineral deposits (other than oil or gas wells).

However, there is no limitation as regards such development expense deductions as in the case of exploration expenses.

Non-Business Deductions. It has been held that "interest" may include carrying charges paid in connection with installment accounts.[18] A taxpayer may also deduct as interest the amount of a discount which is in effect prepaid interest. For example, if a taxpayer gives a note for $500 to a bank and receives only $475, the $25 difference is interest deductible in the year the note is repaid, if the taxpayer is on a cash basis.[19] Where, however, the note is payable in installments, prepaid interest is prorated over the number of installment periods so the portion attributable to each installment is considered as paid when the installment is paid.[20]

The Internal Revenue Code permits a taxpayer to deduct so much of his medical and dental expenses as exceeds 5 percent of his adjusted gross income, but the amount of the deduction shall not exceed $1250 multiplied by the number of exemptions, or $2500, whichever is the lesser.

Travel expenses and living costs may be deducted if they are "primarily for and essential to the rendition of the medical services or to the prevention or alleviation of a physical or mental defect or illness." In this connection, cost of sending a dependent to and maintaining him in another climate has been held deductible as medical expenses.[21]

There are many different types of expenditures which constitute business and non-business income tax deductions. The recent developments represent some of the significant case holdings and government rulings of recent years, which may or may not indicate a trend or trend towards a more realistic approach to the field of deductions. However that may be, it is best for each taxpayer to study his expenditures and apprise his tax consultant not only of the amounts but also their nature. Otherwise a definite tax advantage could be lost forever.

REFERENCES

[1] I. R. C., Section 23 (a) (1).
[2] Coughlin v. Com'r., 203 F. (2) 307 (CA-2, 1953).
[3] Hill v. Com'r., 181 F. (2) 906 (CA-4, 1950).
[4] Fennell, P-H Memo T. C., Par. 53,156.
[5] Sutter, 21 T. C. No. 20 (1953).
[6] Johnson v. United States (U. S. Dist. Ct. Calif. 1941), 45 F. Supp. 377, reversed on other grounds, 135 F. (2) 125.
[7] Regulations 118, Section 39.23 (m)–16 (a).
[8] Regulations 118, Section 39.23 (m)—16 (d).
[9] Bentex Oil Corp., 20 T. C. No. 76 (1953)
[10] Platt v. Com'r., F. (2) (CA-7, 1953).
[11] Rev. Rul. No. 170 (1953).
[12] Rev. Rule No. 131 (1953).
[13] Slaymaker Lock Co., 18 T. C. 1001 (1952), acq. I. R. B. 1953-14.
[14] Waters, 12 T. C. 414 (1949); Scott v. Kelm, P-H tax service par. 72, 404 (U. S. D. C., Minn., 1953).
[15] I. R. Minn. No. 183; I. R. Circular No. 144.
[16] Rev. Rule No. 168.
[17] The Bagley and Sewall Co., 20 T. C. No. 138 (1953).
[18] Noe, P-H T. C. memo, par. 52, 124; McKenzie, P-H T. C. memo, par. 52, 126; Bryant, P-H T. C. memo, par. 52, 129.
[19] Cleaner, 6 T. C. 452 (1946), aff'd. 158 F. (2) 342.
[20] I. T. 3489, 1941-2 C. B. 71.
[21] Strinzham, 12 T. C. 580 (1949), aff'd. 183 F. (2) 519.

Stainless steel processing tank . . . built, inspected, tested, delivered

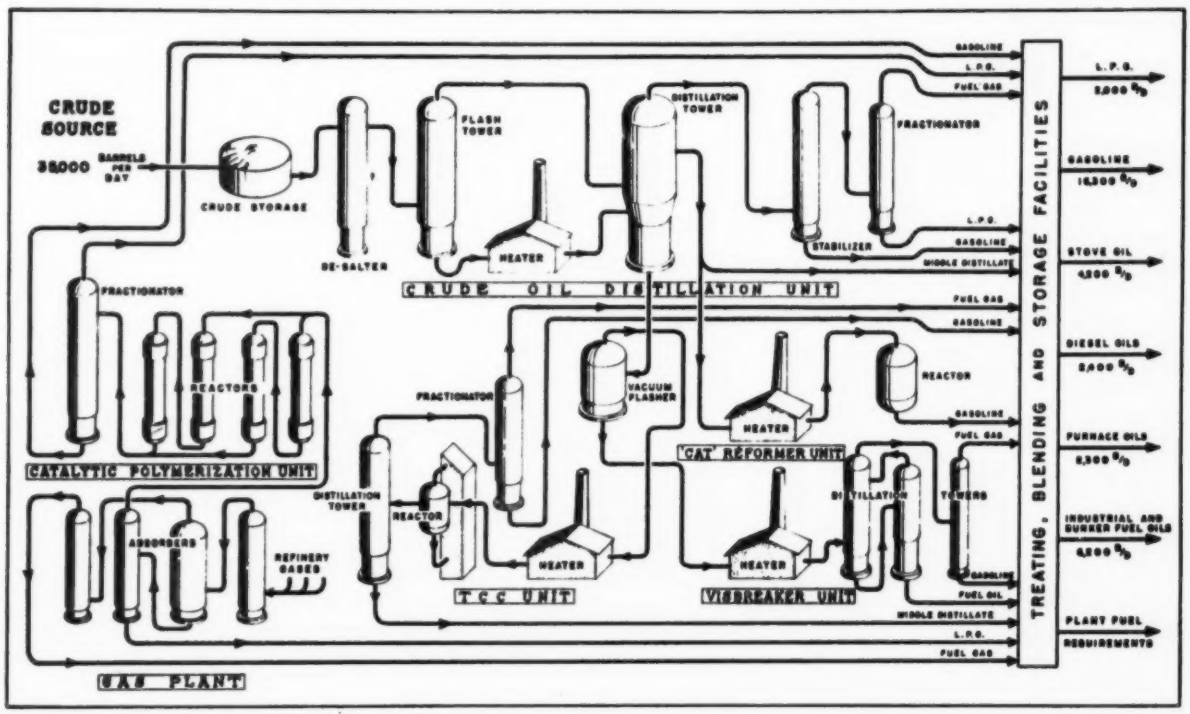
Custom fabrication of tanks and pressure vessels is our business, *our entire business!* Need a tough alloy autoclave with 2½" walls? A Hastelloy reactor? A stainless steel kettle? A column or tower? Come to Nooter first, where fifty years of experience in custom fabrication are ready to serve you. Nooter will build your biggest, most critical pieces of equipment . . . and stay with your job until it's ready to go on-stream. Full responsibility for building, and, if required, for erection at your plant. You can design your equipment, schedule installations and process expansions with confidence . . . with Nooter custom fabrication.

May we show you our shops . . . by mail. Just send us your name on your company letterhead for copy of our latest catalog.

NOOTER CORPORATION

Steel and alloy plate fabricators and erectors . . ."Boilermakers"

1404 South Second Street • Saint Louis 4, Missouri



Process flow sheet for Ferndale refinery.

Northwest Soon to Get No. 1

General Petroleum's $35 million Ferndale refinery will be the first full-scale plant in an area likely to become a major refining center.

The Pacific Northwest, an area in which several large oil companies are either building or planning to build refineries, will this year get its first full-scale oil refinery. General Petroleum Corporation, western affiliate of Socony-Vacuum Oil Company, Inc., has announced that its $35 million installation now under construction at Ferndale, Wash., will be completed by or sooner than August, the target date set when construction began on the plant in May, 1953.

Located on Puget Sound, the refinery is being built by Bechtel Corporation on an 850-acre site about 100 miles north of Seattle. In addition to building the plant, Bechtel did the engineering and design work.

Output. The Ferndale refinery will have a capacity of 35,000 barrels of crude oil a day when it is completed. This daily output will break down into 16,300 barrels of gasoline, 10,000 barrels of diesel and stove oils, 6200 barrels of fuel oil and 2500 barrels of light gases. The light gases will be burned as refinery fuel or consumed in the refining processes.

Plant Installations. Processing units involved in the refinery are crude distillation, thermofor catalytic cracker, thermal cracker (vis-breaker with vacuum distillation tower), thermal reformer and catalytic polymerizer. Storage facilities for crude oil and products will have a capacity of 2 million barrels.

Other facilities of the plant will include a gasoline blending plant, solutizer and treating units, catalyst and chemical handling units, boiler plant, fresh water system, induced cooling towers, waste water oil separator, transformer and electrical distribution system, control laboratories, office buildings, locker rooms and storage buildings.

Added Feature. The refinery will use about 2 million gallons of water each day, most of which will eventually flow into Puget Sound. Before the water leaves the plant, however, it will flow through a $1 million waste water treat-

See NORTHWEST'S FIRST, Page 213

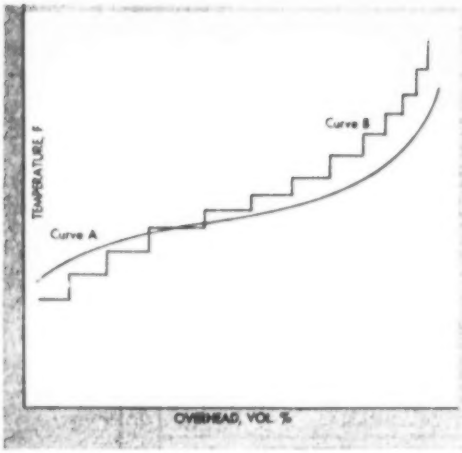


Figure 1. Typical boiling curves.

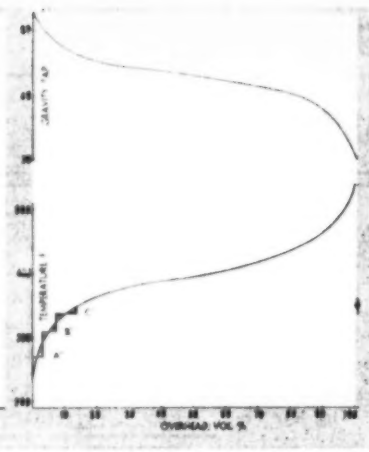


Figure 2. Boiling temperature and gravity from 42.5°. API Mid-Continent kerosine.

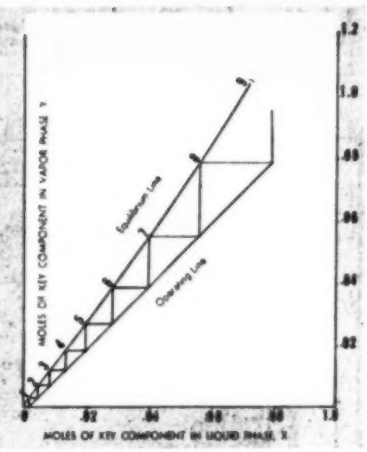


Figure 3. Graphical solution for the number of theoretical trays in a stripper.

Designing Stripping Columns

N. H. Prater, Magnolia Petroleum Company,
Beaumont, Texas

STRIPPERS FOR controlling flash, viscosity and gravities of petroleum fractions usually employ four to six trays. The number of trays are chosen arbitrarily since no correlations have been developed that would apply to complex mixtures of hydrocarbons. However, methods for estimating the number of trays have been worked out for simple mixtures and they may be modified to answer refinery needs.

Petroleum fractions are characterized by true boiling point curves, density and refractive index. The true boiling point distillation attempts to separate the complex mixture into its individual components. The true boiling point distillation curve is usually smooth like Curve A of Figure 1 although under ideal conditions the results of distillation should have appeared in the form of a discontinuous Curve B shown on the same figure.

The proposed calculation method is based upon a true boiling point analysis although the results of ASTM distillations may be used as first approximations. The width of the fractions obtained from these distillations determines the accuracy of the results. The maximum width of the fraction should not exceed 5 percent. The mid-boiling points of the fractions are plotted against percent overhead and the resulting curve is assumed to be made up of an infinite number of pure compounds boiling at the indicated temperatures. The boiling point curve can then be divided into any desired number of hypothetical components which correspond to hydrocarbons normally boiling within these boiling ranges. A similar curve is obtained by plotting gravities of the fractions against the percent overhead.

The number of hypothetical components into which the boiling point curve must be divided for practical calculations depends upon the accuracy desired. For determining the operation of commercial strippers the low boiling portion is the most important one. The width of the hypothetical components in this portion should not exceed 5-7 volume percent. These components are obtained by means of the chord area method which involves drawing plateaus in such a way that the shaded areas on both sides of the curve balance. Each of these hypothetical components is identified by its average boiling point on the TBP curve. The volume percent of the components can then be read from the lower scale.

The boiling points and densities of the components can be used in estimating the critical temperature, critical pressure and molecular weights of these fractions. Critical conditions thus estimated are used in computing fugacity K constants for all ranges of temperature and pressure. Correlations developed by Edmister[1] for predicting fugacity K constants were used in this work.

The resulting information is applied for calculating the design of the stripper by the Sherwood graphical method[3] modified for this purpose.

The method was proposed by Lewis[4] and discussed in detail by Edmister.[2]

The proposed modification extends the Sherwood graphical procedure to include petroleum fractions of unknown compositions. The term wet gas and lean oil used by Sherwood will be defined in this paper as overhead vapors and the bottoms from the stripper respectively. Since the assumed lean oil is removed as a product, it can be treated as being completely denuded. After the desired amount to be removed has been denoted on the TBC, the number of hypothetical components should be determined in such a manner as to insure removal of 95 percent or more of the heaviest component in these fractions. This method simplifies further calculations which are done by trial and error.

Example

An example of these calculations follows. (Abbreviations used in this example are defined on page xxx.)

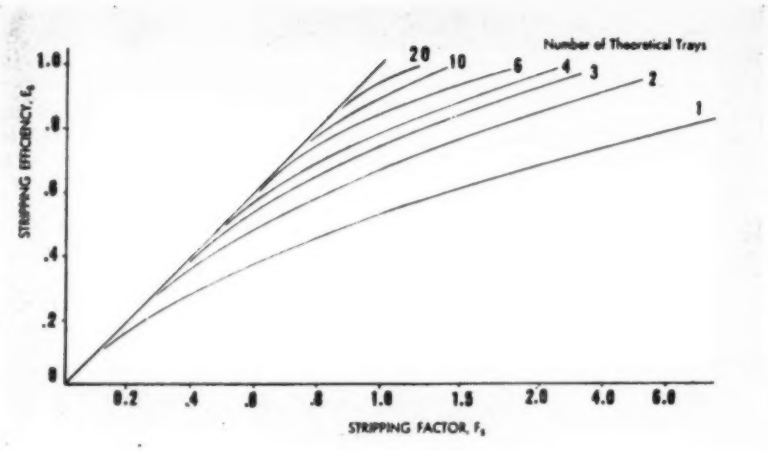


Figure 4. Stripping efficiencies of steam.

Use this rapid method for petroleum fractions to determine

- Steam requirement
- Number of stages
- Optimum design

Design a stripper and find steam rate required to produce a flash point of 158 F. from a 4.25° API petroleum fraction having a flash point of 108 F. The feed rate is 2900 barrels daily. The stripper will be operated at a temperature of 415 F. and a pressure of 25 psia. The tray efficiency has been determined to be 79 per cent.

Step (1)—*Find the Amount of Material to be Removed*

This is determined by a true boiling point distillation by removing a portion overhead until the desired flash point is obtained on the residuum. The results of this distillation are shown in Table 1.

The removal of 13 volume percent of the distillate from the feed produces residuum of 158 F. flash point.

TABLE 1
Flash Point of Residual Fraction

Percent Overhead	Percent Bottoms	Flash Point Test, F.
0	100	108
5	95	130
10	90	146
13	87	158

TABLE 2
Estimation of Low Boiling Hypothetical Components in Feed

COMPONENT	API	Vol. Percent	Mid Boiling Point, F.	Mol. Wt.	Mols./Bbl.	Mols./Hr.
A	51.0	3.0	270	117	2.32	8.41
B	48.6	4.0	310	129	2.73	10.30
C	47.3	6.2	337	140	1.98	12.74
Residuum	40.5	86.8	412	170	1.70	178.30

TABLE 3
Fugacity K Constants for Hypothetical Components

COMPONENT	T_c	P_c	VP at 415 F.	VP P	T_r	VP_r	P_r	f VP	f P	f VP / f P	K*
A	600	430	90	3.6	.825	.21	.058	.865	.965	.897	3.23
B	645	390	58	2.32	.795	.149	.064	.96	.955	1.005	2.53
C	672	370	35	1.40	.775	.095	.068	.97	.95	1.02	1.43

* $K = \frac{VP}{P} \times \frac{f\,VP}{f/P}$

Step (2)—*Determine the Hypothetical Component Breakdown for the Fraction to Be Removed*

The method is illustrated in Figure 2 and results are tabulated in Table 2.

The molecular weights of these hypothetical components were determined using correlations developed by Smith and Watson.[6] The residuum is 86.8 percent of the stripper feed or 2900 barrels per day × 0.868 = 2517 barrels per day. Components A, B, and C were arbitrarily set at 3, 4 and 6.2 volume percent, respectively, so that areas on both sides of the curve are equal.

Step (3)—*Determine Operating Conditions for the Stripper*

This depends on the tower conditions from which the feed to the stripper is obtained. In this case the operating temperature and pressure are 415 F. and 25 psia, respectively.

Step (4)—*Find Fugacity K Constants for Each Hypothetical Component.*

The results of this calculation are shown in Table 3. Correlations of critical temperature and critical pressure against average atmospheric boiling point and API gravity presented by Smith and Watson[6] were used for determining critical properties of the hypothetical components. The fugacity coefficients were obtained from charts developed by Hougen and Watson[7] correlating fugacity coefficients against reduced temperature and reduced pressure.

Step (5)—*Estimate the Percent of Each Hypothetical Component to Be Removed for Obtaining 158 F. Flash Point Residuum*

From Table 1 the fraction to be taken overhead from the stripper is 13 volume percent of the feed while the total volume of components "A", "B" and "C" are found from Table 2 to be 13.2 volume percent of the feed. As a first approximation, assume that components "A" and "B" are completely removed. Components "A" and "B" constitute 7 volume percent of the feed. To obtain a total of 13 volume percent, $\frac{6}{6.2} \times 100 = 97$ percent of the "C" component must be also removed. This is shown in Table 4.

TABLE 4
Determination of the Overhead Fraction

Component	Mols./Hr. in Feed*	Fs	Mols./Hr. Removed
A	8.41	1.0	8.41
B	10.30	1.0	10.30
C	12.74	0.97	12.32
Total	31.45		31.03

* From Table 2.

Step (6)—*Estimate the Minimum Steam Requirement*

This is determined by solving the following equation developed by Edmister.[2]

$$\frac{V_o}{L_o} = \frac{F_s(1+\Sigma X)}{K(1+\Sigma Y)} \qquad (1)$$

where the fugacity K constant is for the key component. The key component is defined as the component whose K value is closest to unity. In this example this is component "C." With the exception of V_o all other factors in Equation (1) are obtained from Tables 2, 3 and 4. By substituting these values into the equation, the following expression is obtained:

$$\frac{V_o}{178.3} = \frac{0.98\left(1+\frac{31.45}{178.3}\right)}{1.43\left(1+\frac{31.03}{V_o}\right)}$$

By solving the equation the value of V_o is found to be equal to 89. For the minimum steam rate determined from Equation (1), an infinite number of trays is required. The steam rate corresponding to optimum design conditions is approximately twice the minimum requirement. The steam rate for this example is assumed to be 178 mole. per hour.

Step (7)—*Construct the Vapor-Liquid Equilibrium Curve for the Key Component*

The curvature of the equilibrium curve may be estimated by determining the amount of the key component in the liquid at different points and solving for the corresponding amount of vapor in equilibrium with the liquid by Equation (2).

$$\frac{X}{Y} = \frac{(1+\Sigma Y)}{K(1+\Sigma Y)} \qquad (2)$$

These points are determined for the conditions existing at the top, bottom and a middle point of the column. For petroleum fractions the curvature of the equlibrium curve is very slight and three points are sufficient for estimating the curvature. The coordinates of these three points are shown in Table 5.

The vapor-liquid equilibrium curve is plotted on the basis of the information presented in Table 5 as shown in Figure 3.

TABLE 5

Vapor-Liquid Equilibrium Values for the Key Component

Mols of Key Component in Vapor-Y	Mols of Key Component in Liquid-X
0	0
0.075	0.04
0.104	0.0716

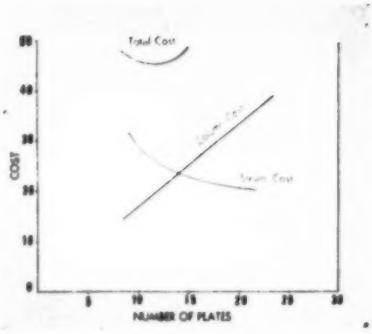


Figure 5. Interrelation of construction and operating costs of stripper.

Step (8)—*Construct the Operating Line for the Key Component to Determine the Number of Trays*

The operating line is drawn as a straight line having a slope of L_o/V_o and its origin at X_L on the Y = 0 axis. The slope of the operating line $\frac{L_o}{V_o} = \frac{178.3}{178} = 1.002$ where L_o and V_o are determined in Step 2 and 6, respectively. X_L is found from the amount of hypothetical components in the feed and overhead as shown in Table 1.

$$X_L = \frac{31.45 - 31.03}{178.3} = 0.001402$$

The number of theoretical trays as determined by the stepwise method shown in Figure 3 is 8.7. This corresponds to 11 actual trays at 79 percent tray efficiency. The optimum choice of number of trays and steam rate depends on the cost of the column and the cost of steam. This is illustrated by Figure 5 where the two costs are plotted against the number of trays.

Step (9)—*Check Step 5 for the Percent of Each Hypothetical Component Removed for Obtaining 158 F. Flash Point Residuum*

The steam rate from Step 6 is 178 moles. per hour. From Step 7, 8.7 theoretical trays are required to produce a 158 F. flash point residuum. Stripping factors, F_s, for each component are calculated by Equation (3).

$$F_s = \frac{K V_o (1+\Sigma Y)}{L_o (1+\Sigma X)}$$

where X and Y are obtained from Table 4. With these factors, stripping efficiencies for each component can be found from Figure 4. For example, the stripping factor for the key component is as follows:

$$F_s = \frac{1.43 \times \left(1+\frac{31.03}{178}\right)}{178.3 \left(1+\frac{31.45}{178.3}\right)} = 1.42$$

From Figure 4 the stripping efficiency is 98 percent. The results of these calculations are shown in Table 6.

TABLE 6

Determination of Overhead Fraction

Component	Mols. Hr. in Feed	F	E	Mols. Hr. Removed
A	8.41	3.2	1.0	8.41
B	10.30	2.31	1.0	10.30
C	12.49	1.42	0.98	12.60
Total	31.45			31.31

Table 6 shows 98 percent removal of the key component against 97 percent desired. This is sufficiently close to the desired performance and no further adjustments are necessary. Otherwise, Steps 5, 6 and 7 should be repeated using adjusted steam rates.

The information developed by the proposed method of stripper calculations is used in economic studies of optimum design. When the tower is operated at elevated pressures, expensive high pressure and not exhaust steam must be used. The importance of the value of steam employed in the stripper increases with steam pressure. The information may be presented in the general form shown in Figure 5. The optimum cost corresponds to the minimum point on the total cost curve.

The validity of the proposed method has been verified repeatedly in plant operation.

ABBREVIATIONS

ΣY = Sum of Y values for components (excluding the stripping steam) present in the vapor phase
ΣX = Sum of X values for components (excluding residuum) present in the liquid phase
L_o = Moles. of residuum
K = Fugacity equilibrium constant at average conditions
V_o = Moles. of stripping medium
F_s = Stripping factor
E_s = Stripping efficiency—percent
T_c = Critical temperature—°F.
P_c = Critical pressure—psia
VP = Vapor pressure at average conditions—psia
P = Tower pressure—psia
T_r = Reduced temperature
P_r = Reduced pressure
VP_r = Reduced vapor pressure
f = Fugacity

ACKNOWLEDGMENT

The author is indebted to Magnolia Petroleum Company for permission to publish this article, and to V. A. Kalichevsky for his helpful criticism and suggestions.

REFERENCES

[1] Edmister, W. C., Pet. Eng., **18**, No. 10, 32-46 (1947).
[2] Edmister, W. C., Pet. Eng., **19**, No. 1, 200-8 (1947).
[3] Hougen, O. A., and Watson, K. M., "Chemical Process Principles," p. 622. John Wiley and Sons, New York (1949).
[4] Lewis, W. K., Tran. Aiche, **20**, 1 (1927).
[5] Sherwood, T. K., "Absorption and Extraction," McGraw-Hill Book Co., New York (1937).
[6] Smith, R. L., and Watson, K. M., Ind. Eng. Chem., **29**, 1408-14 (1937).

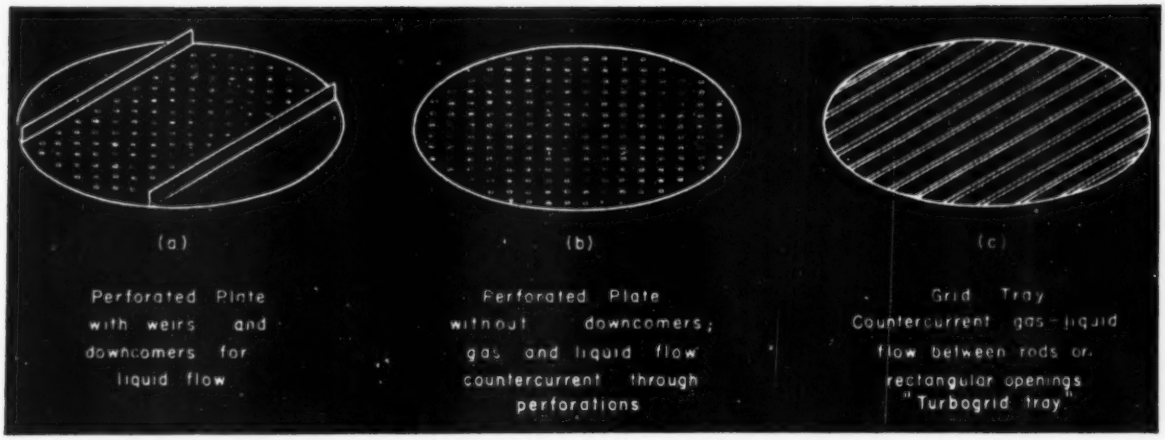

(a)
Perforated Plate with weirs and downcomers for liquid flow
(b)
Perforated Plate without downcomers; gas and liquid flow countercurrent through perforations
(c)
Grid Tray
Countercurrent gas-liquid flow between rods or rectangular openings
"Turbogrid tray"

Figure 1. The various types of perforated plates take these configurations:

(a) With weirs and downcomers;

(b) Without downcomers, gas and liquid flow through perforations; and

(c) Grid tray. Countercurrent flow between rods or rectangular openings.

How to . . .

Calculate Capacities of Perforated Plates

Widespread current interest in perforated trays stimulated this study which resulted in an original method for calculating vapor and liquid capacities.

Frederick A. Zenz, Hydrocarbon Research, Inc., New York

IN RECENT YEARS the petroleum and chemical industries have begun to explore anew the use of perforated plates in fractionation and similar countercurrent two-phase contacting operations. Nearly every clean stock or light ends fractionator designed today is provided with pierced plates. In contrast to earlier misconceptions regarding the limited range of capacity of such trays, more thorough experimentation has shown that proper consideration of hole diameter linked with the similarity in design principles to those underlying bubble cap trays permits designs of equal if not wider ranges of operability.

In bubble tray design the process engineer contends with entrainment or flooding considerations as the upper limit and tray stability as the lower. In perforated plate design entrainment and flooding again impose upper capacity limitations while the lower limit on the range of operable vapor and liquid loads is generally governed by conditions leading to excessive liquid weepage through the perforations and onto the tray below. Such weepage is a mechanism of liquid bypassing leading to rapid loss of plate efficiency. It should be pointed out that the type of plate under discussion is one equipped with downcomers and weirs in which the liquid flow path is identical to that on bubble cap trays. The perforations are intended merely to serve as vapor passages from tray to tray up the tower as though a bubble cap tray had been shorn of caps and risers. Such conventional perforated plate is shown schematically in Figure 1 (a). In contrast, Figure 1 (b) and 1 (c) illustrate two other forms of so-called perforated plates which are more descriptively referred to as "shower decks." In general such shower decks have a narrower range of efficient operable loadings; their design differs in principle from that of the conventional perforated plate under discussion here.

A number of publications on the capacity and efficiency of perforated plates have appeared over the past decade, yet the data are insufficient to permit generalizations as to loading, tray spacing, and hole size relationships. Mayfield et al presented the first useful bit of information for 3/16-inch holes in the form of a table giving weepage limits and 18-inch tray spacing limits for the air water system. Their data are shown graphically in Figure 2 in what may be termed a

NOMENCLATURE

C_o = orifice coefficient
C, C_1, C_2 = Constants
δ_c = cap diameter, inches
δ_o = riser diameter, inches
g = gravitational constant
ΔH = head loss, feet of gas
l_1, l_2 = liquid weepage rate
n = number of slots in cap
ΔP = pressure drop, force/area
Q_c = cap vapor capacity, cfm
Q_o = hole capacity, cfm
S_o = operating slot opening, length
V_o = hole velocity, feet per second
V_r = reversal velocity, feet per second
V_s = riser velocity, feet per second
ρ_v = vapor density, pounds per cubic foot
ρ_L = liquid density, pounds per cubic foot
ω = slot width, inches

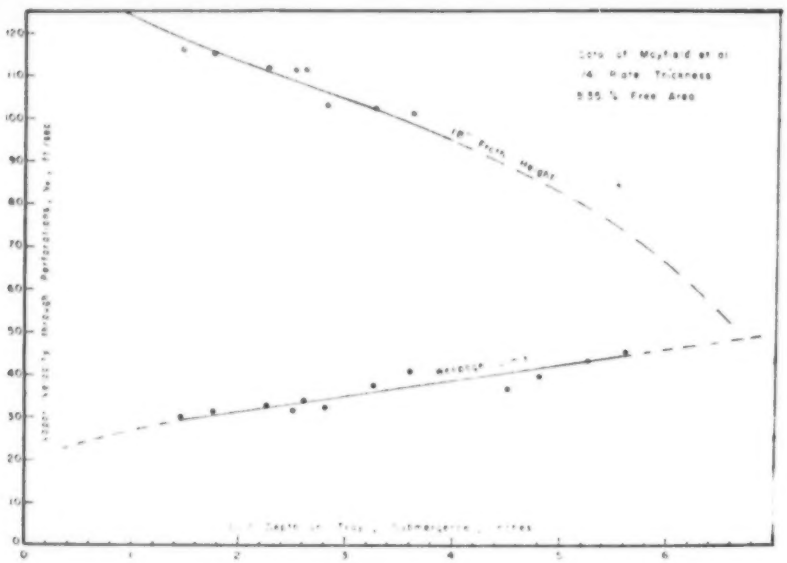


Figure 2. Operating characteristics for the Air-Water system on perforated plates with 3/16-in. holes (Mayfield).

capacity chart based on analogy to the slot opening and submergence correlation for bubble cap trays. Mayfield et al suggest that for other systems the weepage limit be taken as the vapor rate giving the same dry tray pressure drop as the air used in their tests at identical submergences. This procedure is exactly the same as used in bubble cap tray design. Before presenting additional data on the effects of liquid properties and hole size let us first consider the generalized form of perforated plate capacity charts in the light of Mayfield's suggested design procedure and then derive the analogous basis from bubble cap tray design considerations.

Perforated Plate Capacity Charts

A plot of hole velocity versus liquid submergence with lines of constant tray spacing and a superimposed weepage limit such as shown in Figure 2 completely defines a capacity chart for a particular gas, liquid, and hole size. If we now eliminate the gas density as a variable by considering the weepage and entrainment limits to be identical at equivalent pressure drop conditions (equal vapor kinetic energies) the generalized capacity chart takes the form shown schematically in Figure 3. Such a chart applies to a fixed hole size, liquid surface tension and liquid foaming tendency.

The gas pressure drop through the plate (for large holes of the order of $^1/_{10}$ inch and larger) is essentially the sum of equivalent liquid depth on the tray (weir height plus flowing crest height over weir plus one half the liquid gradient) and the gas pressure drop through the dry plate. The dry tray loss may be correlated by the orifice equation with the proper value of the coefficient:

$$V_o = C_o\sqrt{2g\Delta H} \qquad (1)$$

$$= C_o\sqrt{2g\Delta P/\rho_G}$$

$$\text{or } V_o\sqrt{\rho_G} = C_o\sqrt{2g\Delta P} \qquad (2)$$

As indicated by Equation (2) any number of plates exhibiting equal dry tray pressure drops operate with such combinations of hole velocities and gas densities that the left hand side of Equation (2) is a constant. The condition of equal gas pressure drops is therefore equivalent to considering plate action to be identical at equal values of liquid submergence and the product of hole velocity times the square root of vapor density as depicted in Figure 3. Stated in still another manner, liquids of equal foaming properties will exhibit foam heights correlated by the depth of liquid on the tray and the kinetic energy of the vapors issuing from the holes. It is therefore possible in design to predict for various liquid submergences the range of operable vapor rates ranging from near weepage to the entrainment limit for the desired tray spacing. Though in design work it is more convenient to think in terms of hole velocity rather than volumetric throughput, the ordinate of a capacity chart could be multiplied by the hole area making the generalized chart a plot of $Q_o\sqrt{\rho_G}$ versus submergence. For a particular hole size or plate, constant $Q_o\sqrt{\rho_G}$ corresponds to constant dry tray pressure drop for any gas. This is then directly analogous to the slot opening versus submergence correlation used in the design of bubble cap trays.

Bubble Cap Analogy—As in the case of perforated plates the product of $Q_o\sqrt{\rho_G}$ governs the pressure drop through a particular cap and riser assembly. The cap pressure loss represents the sum of riser, reversal, and slot losses:

$$\Delta P_{cap} = \Delta P_{riser} + \Delta P_{reversal} + \Delta P_{slot} \qquad (3)$$

where:

$$\Delta P_{riser} = 0.111\,\delta_o\,V_o^{2.00}\,\rho_G^{1.00}/\rho_L \qquad (4)$$

Table 1
Experimental Tray Characteristics

Perforations		Plate		
Pattern	Diameter, inches	Material	Thickness, inches	% Hole area
	0.25	Lucite	0.125	19.6
	0.125	Lucite	0.125	19.6
	0.0625	Lucite	0.125	4.9
	0.0625	AL	0.064	31.0
	0.0525	Lucite	0.125	6.95
	0.04	Lucite	0.125	4.01
	0.04	AL	0.04	4.01

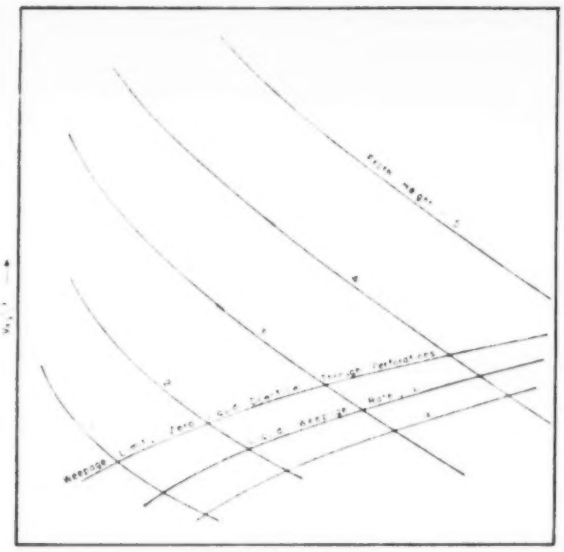


Figure 3. Schematic generalized capacity chart for a perforated plate.

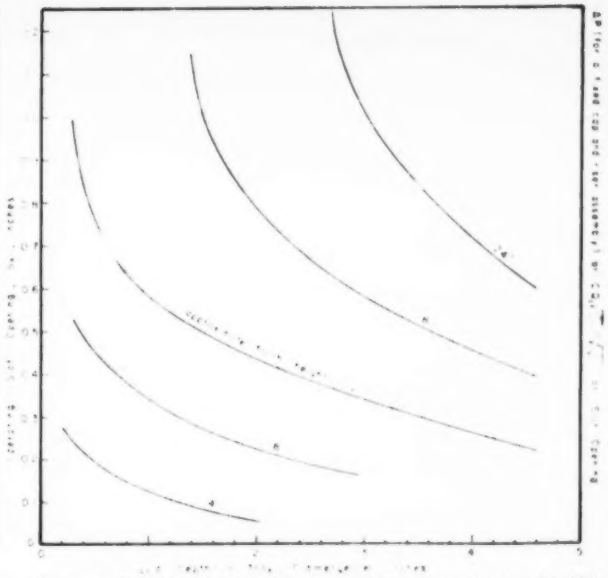


Figure 4. Generalized correlation of operating characteristics of bubble cap trays.

$$\Delta P_{reversal} = 2.22 V_r^{1.31} \rho_G^{0.86} \delta_m^{1.62} \rho_L \delta_r^{2.62} \quad (5)$$

$$\Delta P_{slot} = S_m = \left[\frac{2.43 Q_c \sqrt{\rho_G}}{n \omega \sqrt{\rho_L}} \right]^{1.} \quad (6)$$

For a particular cap and riser assembly V_m and V_r may be expressed in terms of the cap vapor capacity, Q_c, or more simply in terms of slot opening, S_m, through Equation (6). Such procedure leads to an equation of the form:

$$\Delta P_{cap} = (C_1 \rho_L^{0.04} S_m^{2.31}) + (C_2 S_m^{2.56} / \rho_L^{0.18}) + S_m \quad (7)$$

According to Equation (7) cap loss is essentially a function of operating slot opening; the effect of tray liquid density is slight in view of the small values of the exponents on ρ_L and the normal variation in densities of most common liquids. The slot opening—submergence—tray spacing correlation for bubble cap trays is therefore a correlation in terms of cap ΔP. Thus in Figure 4, which is the analogous plot to Figure 3, the ordinate may represent pressure drop or volumetric capacity for a particular cap and riser assembly as well as operating slot opening. For conditions of equal ΔP, perforated plates correlate in terms of volumetric capacity with the product $Q_c \sqrt{\rho_G}$ (Figure 3) whereas bubble caps correlate in terms of volumetric capacity with the product $Q_c \sqrt{\rho_G} / \sqrt{\rho_L}$. This influence of liquid density in the case of bubble caps is not surprising since in most instances one boundary of the slot dimension, through which the vapor issues, is a liquid interface which rises or falls as vapor load increases or decreases. In contrast, the openings through which vapor issues onto a perforated plate are fixed and independent of liquid movement or vapor volume. However, the experimental data available to date are insufficient to draw a definite conclusion that liquid density does not influence the equivalent dry plate loss. Perhaps the ordinate of Figure 3 should actually be $Q_c \sqrt{\rho_G} \sqrt{\rho_L}$. More probable is the comparison with skirted bubble caps mounted flush with the tray floor operating at vapor rates so high that the slots are fully blown open. Under such conditions the factor $\sqrt{\rho_L}$ is not pertinent. In either case the relatively narrow range of densities of liquids normally encountered makes $Q_c \sqrt{\rho_G}$ at present a sufficient correlant. On the whole the analogy between perforated plates and bubble cap trays appears to be very close; its final exact resolution would require very detailed and controlled academic studies with liquids of widely varying densities and surface tensions.

Experimental Results In order to expand upon the work of Mayfield and obtain a broader field of capacity data a series of simple air-water tests were carried out in the apparatus shown schematically in Figure 5. Submergence was varied by changing

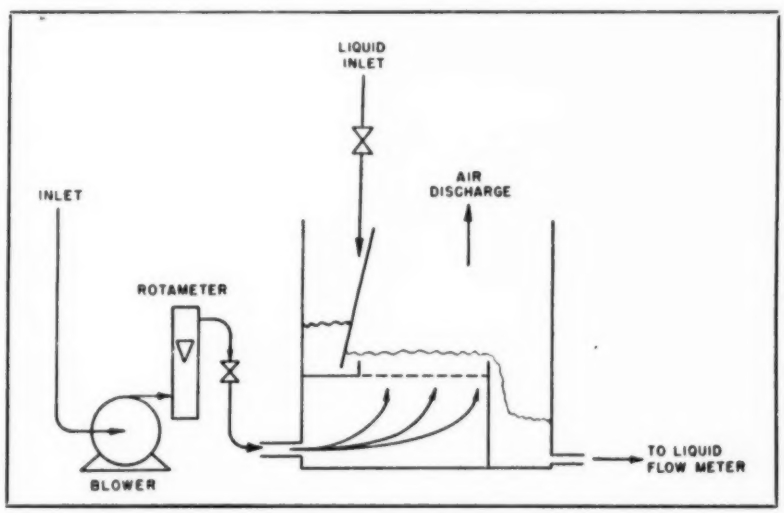


Figure 5. Schematic arrangement of experimental apparatus for tray tests.

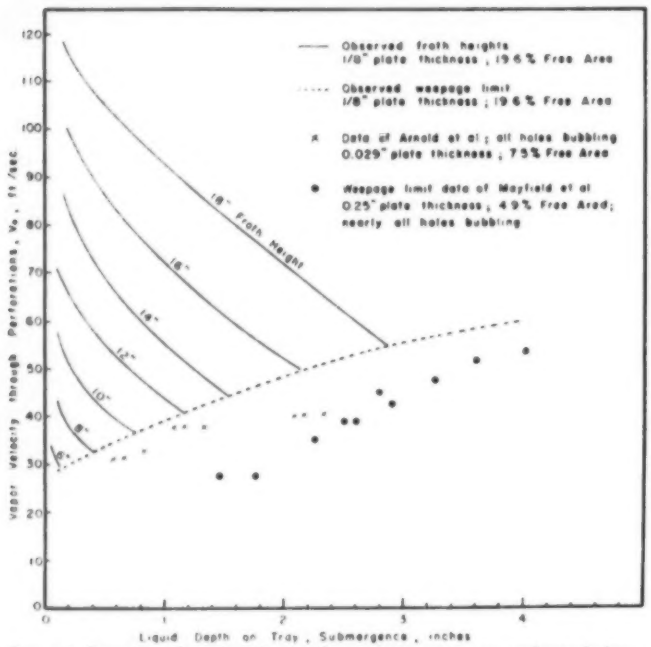

Observed froth heights
1/8" plate thickness ; 19.6 % Free Area
Observed weepage limit
1/8" plate thickness ; 19.6 % Free Area
Data of Arnold et al ; all holes bubbling
0.029" plate thickness ; 7.5% Free Area
Weepage limit data of Mayfield et al
0.25" plate thickness ; 4.9 % Free Area ; nearly all holes bubbling
18" Froth Height
16"
14"
12"
10"
8"
6"
Vapor Velocity through Perforations, Vo, ft/sec
Liquid Depth on Tray, Submergence, inches

Figure 6. Operating characteristics for the air-water system on perforated plates with ¼-inch holes.

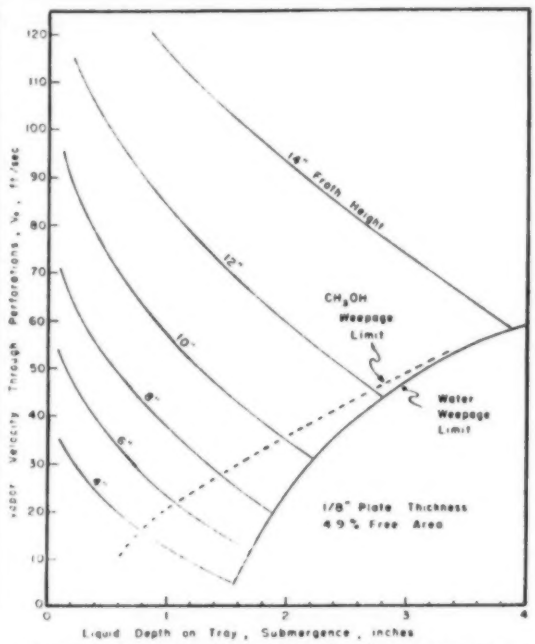


Figure 8. Operating characteristics for the air-water system on perforated plates with 1/16-inch holes.

overflow weir heights and liquid circulation rates. At each submergence the froth or foam heights were measured at several vapor rates. In the preliminary exploratory study seven different plates were drilled. The perforation diameters, plate thicknesses, and drilling patterns used are listed in Table 1. The test procedure was repeated with several liquids to explore mainly the effect of liquid surface tension as well as the foaming tendencies of specific stocks.

Figure 6 presents the air-water data for the ¼-inch hole plate. The weepage limit data of Mayfield and Arnold are also plotted for comparison. Figures 7 and 8 present the methyl alcohol and water data for the ⅛ and 1/16-inch holes. The effect of the lower surface tension of the alcohol manifested itself mainly in requiring higher hole velocities to prevent weepage. The entire series of tests with all five hole sizes resulted in a number of capacity design charts drawn from Figures such as 6, 7, and 8 from which the following qualitative conclusions could be drawn:

1. Lowering the surface tension of the tray liquid increases the weepage limit vapor rate.

2. Reducing the hole size reduces the weepage limit.

3. At constant hole velocity and submergence smaller holes permit closer tray spacing.

4. Decreasing the plate thickness raises the weepage limit.

5. Increasing percentage free area increases weepage limit and tray spacing.

These conclusions coupled with capacity charts for various hole sizes, surface tensions, and foaming properties (Figures 2, 6, 7 and 8) permit the process engineer to size and specify perforated plates with the same degree of assurance now used in designing bubble cap trays. It is anticipated that efficiency studies correlated in terms of perforated plate capacity charts may eventually outmode bubble cap trays entirely in towers servicing clean feed stocks.

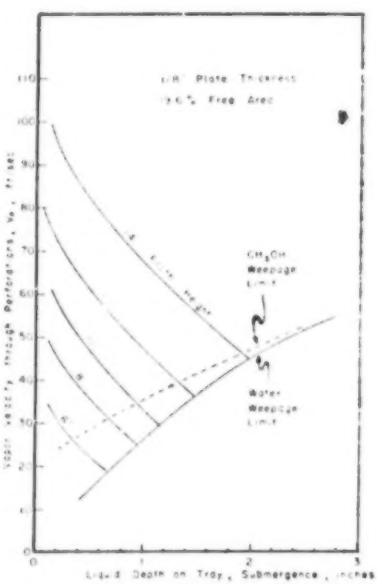

1/8" Plate Thickness
19.6 % Free Area
CH3OH Weepage Limit
Water Weepage Limit
Vapor Velocity through Perforations, Vo, ft/sec
Liquid Depth on Tray, Submergence, inches

Figure 7. Operating characteristics for the air-water system on perforated plates with ⅛-inch holes.

BIBLIOGRAPHY

[1] Arnold, D. S., Plank, C. A., Schoenborn, E. M., Chem. Eng. Prog., **48**, 633-42 (1952).

[2] Eld, A. C., Petroleum Refiner, **32**, 157-61 (1953).

[3] Grigoriev, A. A., Chemical Machine Construction (U.S.S.R.), No. 6, 3-9 (1938); No. 7, 8-10 (1939).

[4] Gunness, R. C., Baker, J. G., Ind. Eng. Chem., **30**, 1394 (1938).

[5] Kamei, S., Takamatsu, T., Chem. Eng. (Japan) **15**, 25-8 (1951).

[6] Kamei, S., Takamatsu, T., Umeshita, I., Chem. Eng. (Japan), **15**, 19-24 (1951).

[7] Karim, B., Nandi, S. K., Jnl. Indian Chem. Soc., Ind. News Ed. XI, 12-26 (1948).

[8] Keck, D. R., Pet. Proc., **7**, 987-9 (1952).

[9] Kirschbaum, E., "Distillation and Rectification," Chemical Publishing Co., New York, 1948.

[10] Kirschbaum, E., Andrews, C. A., Jnl. Inst. Petr. Tech., **22**, 803 (1936).

[11] Langdon, W. M., Tobin, D. J., Ind. Eng. Chem. Anal. Ed. **17**, 800 (1945).

[12] Mayfield, F. D., Church, W. L. Jr., Green, A. C., Lee, D. C. Jr., Rasmussen, R. W., Ind. Eng. Chem., **44**, 2238-49 (1952).

[13] Oldershaw, C. F., Ind. Eng. Chem. Anal. Ed. **13**, 265 (1941).

[14] Pelsakov, I. A., Konunetzkii, B. I., Jnl. Chem. Ind. (U.S.S.R.), No. 8, 21-22 (1938).

[15] Peters, W. A. Jr., Ind. Eng. Chem., **14**, 476 (1922).

[16] Stabnikov, V. N., Trudy Voronezh Khim. Tekh. Inst., **3-4**, 177-95 (1939); Khim. Referat. Zhur., **1940**, 123, No. 7; Chemical Machine Construction (U.S.S.R.), No. 2, 9-11, (1940).

[17] Zhavoronkov, N. M., Fourmer, I. E. Kislorod, U.S.S.R., No. 5, 9-19, October (1947).

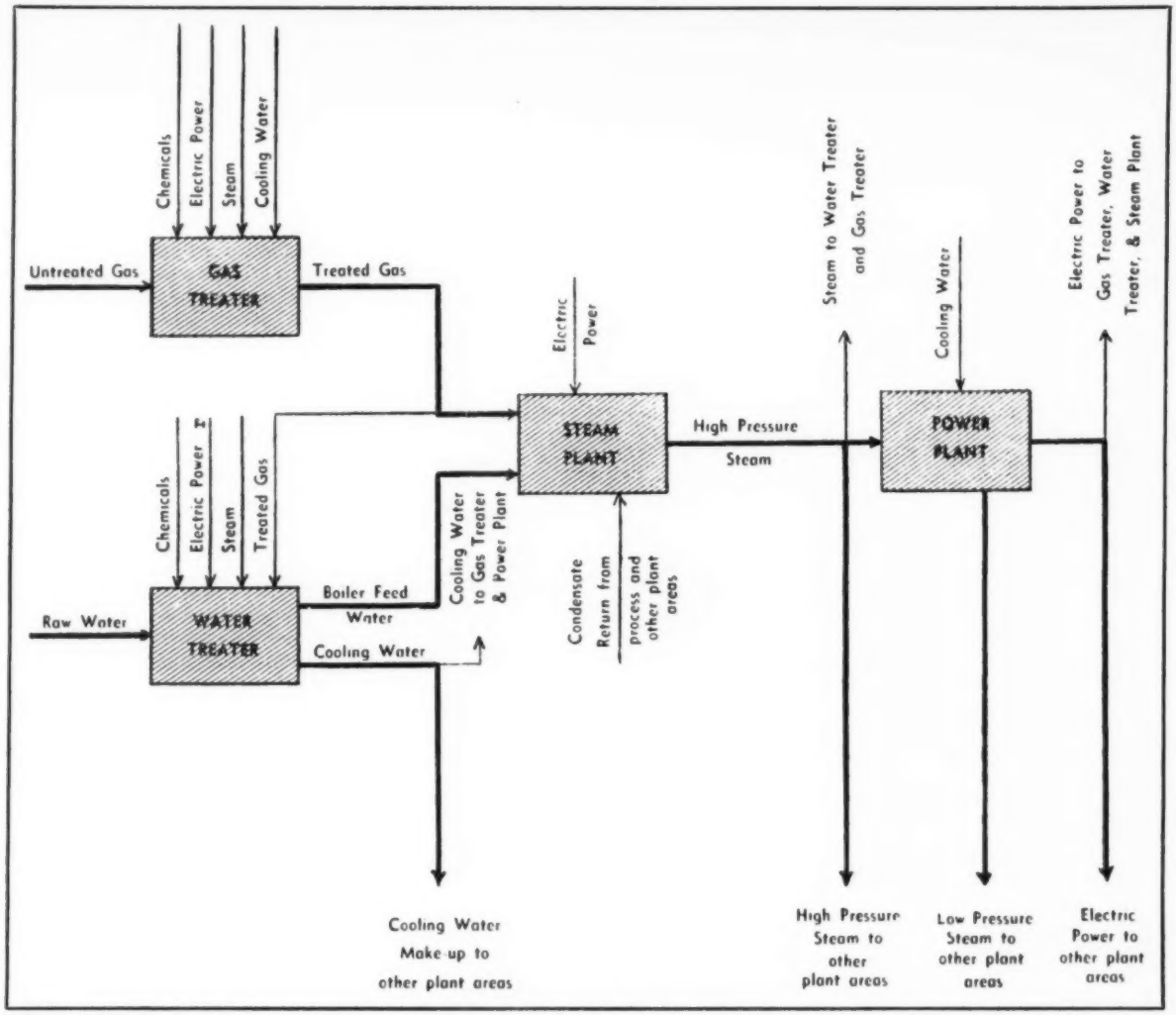


Figure 1. Diagram showing interdependence of utility facilities and main elements of cost (except labor, maintenance and repair and depreciation which are omitted for sake of simplicity).

Calculating Engineering Economics

- **1. Utility Costs**
- 2. Overhead Costs
- 3. Cost Classifications

Follow these clearly labeled and described guideposts in building up utility costs for new process units.

Douglas S. Sherwin,* Phillips Chemical Company, Bartlesville, Okla.

ONE OF THE more vexing and most often compromised tasks met in problems of engineering economic analysis is estimating the cost of utilities. This should not, indeed, be surprising, for estimating utility costs presents many difficulties. The utilities area is fundamentally a multi-product plant, and the difficulties in estimating manufacturing costs for each of several products of an integrated plant are of course notorious. Moreover, the several units composing

* Present address: On loan service to Office of Synthetic Rubber, RFC, Washington 25.

Calculating Utility Costs . . .

the utilities area are inter-related to a degree seldom matched in multi-product plants, and this adds to the general complexity of the problem. The interdependence of the various elements entering into the cost of utilities is illustrated in Figure 1.

Defects of Current Methods—Utility costs should be estimated, first of all, with appropriate regard to their final importance in the study being undertaken. The magnitude of utility costs is, in certain study projects, of no practical significance to the final result. In such cases, very much attention to the cost of utilities is not only unwarrantable, but censurable.

Secondly, utility costs should be estimated with due appreciation of the end uses which they are intended to serve in the study. In the economic analysis of a proposed new manufacturing installation, for example, manufacturing costs are desirably estimated not only for capacity operation of the facilities but for various levels of output as well. As the level of output of the plant is varied, the demand for utility services naturally varies. Where the demand for a utility service is below the capacity for producing that utility, then the cost per unit of service will of course be higher than if the utility plant were to operate at full capacity. Hence, if the profitability of the new project is to be determined for various levels of output, it is necessary to know how the cost of utilities will vary with output. Hence, the apparatus used for estimating utility costs should be capable of providing all the answers necessary for the elaboration of the problem at hand.

Too often, however, the treatment accorded to estimating utility costs neglects one or the other of these considerations. A kind of schizophrenia seems to intrude, producing a vacillation between the notion that utility costs are insignifcant and the notion that their importance does not justify the effort required to estimate them. Unfortunately for better analyses, these notions more often than not have their root in wishful thinking—no conscious attempt actually being made to substantiate either of them. As a result, utility costs are often carelessly estimated in situations where they are truly important and are estimated in a framework which is not flexible enough to provide all the answers that the problem may ultimately demand.

Suggested Pattern for Estimating—Although it is in the nature of utility costs to be complicated, the problem of estimating them, like most problems, yields readily to analysis, systematization, and a few practical, simplifying assumptions. Suppose, for a starting point, that a design for a proposed manufacturing installation has been completed and that the quantity demand for the various utilities to serve all areas of the plant has been established.

To proceed with the estimation of utility costs, the engineering economics group needs in addition, at this point:

(1) The process flow sheet of the proposed utilities plant;

(2) Material requirements and material transfers and recycles;

(3) The manpower requirements up through the utilities foreman;

(4) The capital cost of the proposed utilites facilities.

The responsibility for developing this information, of course, need not be—and normally is not—the cost analyst's. He must, however, work closely with those who are responsible so that he is assured of getting the information in the form and detail needed for his purposes.

With this information at hand, the cost estimation can be carried to completion. Table 1 provides a suggested framework for organizing the elements of cost which enter into the production of each utility service. The guide for the organization of these tables is the process flow sheet; the details for the tables are embodied in the other information which it has been indicated must be at the disposal of the engineering economics group.

It will be quickly noted that the estimation of costs from this point on is not a straightforward derivation. This is entirely due to the complex interdependence which is the distinguishing characteristic of utility costs. Figure 1 shows clearly what the problem is. Among the elements of cost entering, for example, into the cost of producing treated gas are the costs of electric power, steam, and cooling water. But these costs are themselves dependent on the cost of treated gas. This situation recurs throughout the utilities area and prevents the estimation of utility costs from being a simple derivation from given magnitudes.

The difficulty is not permanent, however; it responds quickly to the simple device of assuming a value for each of the utilities consumed in (say) the Gas Treater and evaluating the cost of treated gas produced. The treated gas, since it is one of the constituents of the cost of producing steam, is then charged to the steam plant at this tentatively estimated cost. With very little experience, it is possible to make educated guesses for the values which have to be assumed, so that the over-all effect of any error on the final cost of the utilities will be of no practical significance. Moreover, it is easy to determine from a glance at the table whether the effect is significant or not. Of course, in the event that a very poor guess is made in respect to a cost element which is a major constituent of the cost of the utility, then the assumption will have to be revised on the basis of the newly computed figure in the manner common to all trial and error computation. One can confidently expect, however, that this will happen rarely and that on the infrequent occasion when it does happen, a single revision should suffice to give the necessary accuracy.

With this general approach, the cost of each utility service can be estimated. There are, however, still a few loose ends that have to be tied before any guide for estimating utility costs can be regarded as complete. These have reference to methods of handling low pressure steam, steam condensate return, and depreciation.

Low pressure steam is best handled as if it were a by-product of the power

Reprints Available . . . .

PETROLEUM REFINER has available a limited number of reprints on the subjects listed below:

43.	"Applying Graphical Methods to Square Footing Design," Charles Fork	$ .25
48.	"Enthalpy of Petroleum Fractions," Carol F. Bauer, John F. Middleton	.50
99.	"Hyperforming—Newest Development in Refining," Clyde Berg	.25
103.	"Production of High-Octane Gasoline Components," A. A. Draeger, G. T. Gwin, C. J. G. Leeseman, M. R. Morrow	.50
122.	"Chemical Addition Agents for Lubricating Oils," W. D. Thomas	.25

Please order by number, sending cash or check with order.

Address

Reprint Department

PETROLEUM REFINER

Box 2608 Houston 1, Texas

TABLE 1

Framework for Estimating Utility Costs

	GAS TREATER			WATER TREATER: Boiler Feed Water			WATER TREATER: Cooling Water			STEAM PLANT			POWER PLANT		
	Quantity	$ Unit	$ Day	Quantity	$ Unit	$ Day	Quantity	$ Unit	$ Day	Quantity	$ Unit	$ Day	Quantity	$ Unit	$ Day
Materials Cost:															
a. Raw Materials															
b. Operating Materials															
c. Less Credits (if any)															
Sub-Total: Materials Cost	xxxx	xxxx		xxxx	xxxx		xxxx	xxxx		xxxx	xxxx		xxxx	xxxx	
Labor Cost (Including Payroll Overhead):															
a. Operating	xxxx	xxxx		xxxx	xxxx		xxxx	xxxx		xxxx	xxxx		xxxx	xxxx	
b. Supervisory	xxxx	xxxx		xxxx	xxxx		xxxx	xxxx		xxxx	xxxx		xxxx	xxxx	
Sub-Total: Labor Cost	xxxx	xxxx		xxxx	xxxx		xxxx	xxxx		xxxx	xxxx		xxxx	xxxx	
Services Cost:															
a. Utilities:															
i. Electric Power															
ii. Steam															
iii. Cooling Water															
iv. Other															
b. **Maintenance and Repairs:**															
i. Labor	xxxx	xxxx		xxxx	xxxx		xxxx	xxxx		xxxx	xxxx		xxxx	xxxx	
ii. Materials	xxxx	xxxx		xxxx	xxxx		xxxx	xxxx		xxxx	xxxx		xxxx	xxxx	
iii. Depreciation on Maintenance Facilities	xxxx	xxxx		xxxx	xxxx		xxxx	xxxx		xxxx	xxxx		xxxx	xxxx	
Sub-Total: Services Cost	xxxx	xxxx		xxxx	xxxx		xxxx	xxxx		xxxx	xxxx		xxxx	xxxx	
Depreciation on Utility Facility	xxxx	xxxx		xxxx	xxxx		xxxx	xxxx		xxxx	xxxx		xxxx	xxxx	
Total Cost of Utility Service															

plant—which indeed it is. It is in the nature of a by-product that its cost of manufacture cannot be determined, except in an artificial way. In the present instance, if power is to be generated by the expansion of high pressure steam, low pressure steam is the result. Properly speaking, no cost of manufacture attaches to it. But it does, quite obviously, have a value, and this value is assignable as a credit to the power plant. The question then becomes "what logic governs the value of low pressure steam?"

Opinion may differ on the answer to this question. My recommendation would be that, to the extent it is usable in the plant, it be assigned the same value as high pressure steam. This may seem a remarkable suggestion in view of the fact that low pressure steam obviously does not possess the same potentialities as high pressure steam for various heating services or for generating additional power. But "potentiality" for serving these functions is not the same thing as being called upon to fulfill them, and so long as there are services that low pressure steam can satisfy, its availability has the effect of reducing the consumption of high pressure steam. To the extent that low pressure steam cannot be utilized, of course, its value falls to the value of steam condensate less the cost of condensing it.

Opinions differ also in regard to methods of dealing with steam condensate return. According to one view, condensate should be assigned a value and operate as a charge against the steam plant. If this method is employed, condensate can be given a value based on the reasoning that it is the equal of boiler feed water in respect to chemical treatment, and superior in respect to enthalpy and (probably) pressure. The additional value of condensate can then be derived by estimating the cost of fuel and power representing the difference in quality between the boiler feed water and the condensate. The condensate is then charged to the steam plant at this cost and operates as a credit to units in other areas of plant which have discharged condensate.

The advantages of this method of handling condensate return are, however, of dubious value, except in certain circumstances—of which an example might be in the event steam is being supplied to a unit from which return of condensate is either disproportionately low or forgone because uneconomical. The projected sale of steam across the fence to another company when the return of condenate is not provided for is a further example. Generally, however, little is to be gained by going to the extra trouble of attributing a value to steam condensate. Simplicity is served—without loss of accuracy—if the condensate is regarded as having no value and is treated, consequently, neither as a charge to the steam plant nor as a credit to other areas of the manufacturing plant.

A word, finally, about depreciation. Depreciation is included in Table 1 in two places: as part of maintenance service costs and, again, as a charge for the decline in value of the utility facilities due to wear and obsolescence. But although provided for in the table, it is optional, and a matter almost of personal preference, whether it is handled in this way. It may be handled instead by including the depreciation expense for the two items in one figure together with depreciation on process facilities and other fixed capital. If so handled, it must naturally be excluded from costs of providing utility services. The advantage of treating them as indicated in Table 1 is that, since depreciation is a fixed charge, variations in cost due to variations in level of output are more sharply emphasized. The advantage of excluding depreciation charges from Table 1 and handling in a single account is that less work is involved.

Note on Estimating Maintenance Cost Like the utilities area of a manufacturing plant, the maintenance department is a producer of services for the other areas of the plant. This suggests that the cost of supplying maintenance services can be estimated in a manner similar to that which is proposed here for estimating utility costs. The procedure would involve setting up on paper the estimated manpower, capital equipment, and services requirements of the maintenance department and estimating the expenses of these requirements.

At editorial conference . . .

Refiner Makes 1954 Plans

Petroleum Refiner editorial conferees gathered at Cherry Valley Ranch, l. to r. seated: Henry Haley, Cleve Lee, George H. Meason, R. L. Dudley, E. B. McCormick, David Bonner and Dudley Penick. Standing: Al Reese, Bob Spann, Silas Ragsdale, Gilbert Wilson, Bob de Sambre, Dave Willis, Tom Nelson, Bob Phillips, Warren Baker, John McKetta, A. L. Burns, Bill Dudley, George Gibbs and Don Rawlings.

TOPNOTCH THINKING, fellowship and food - these were the ingredients liberally mixed by the six industry guests and 18 staffers who enjoyed Publisher R. L. Dudley's own brand of West Texas hospitality at the recent REFINER editorial conference. An annual affair, the conference is designed to make PETROLEUM REFINER an even better bargain for the readers by inviting the critical analysis of guests who have come prepared to point up the way for better service to our readers.

Based on the theory that if you want to know what a reader is thinking, ask him, the conference's success depends entirely on the selection of guests. The group this year were excellent contributors, and included: E. B. McCormick, Cosden Petroleum Corporation, Big Spring, Texas; Henry Haley with Wyatt C. Hedrick Company, Houston; George H. Meason from Humble Oil & Refining Company's Baytown, Texas refinery; Cleve Lee with Celanese Corporation of America, Bishop, Texas; David Bonner from Gulf Oil Company's Port Arthur plant; and Dudley Penick of Magnolia Oil Company's Gasoline Plant division, Dallas.

Naturally the decisions made at the conference are our secret—but you will shortly see the results in future issues of the REFINER. The guests were furnished with a copy of the agenda well in advance of conference time and invited to solicit the opinions of fellow employes. This they did, and came well armed with bouquets and brickbats.

One conference session was devoted to analyzing the strength and weaknesses of the last 12 issues—were we covering the technical fields properly, which of the articles were outstanding and which might be classified as poor. Another session lit into the regular departments. The guests had all found the newly inaugurated "As Management Sees It" of help to them, like the "Quick Look" section, but thought our "Who's Meeting" department needed pepping up.

Cleve Lee and his deer.

Discussion waxed hot and heavy on such special problems as the advantages and disadvantages of series articles, policies on publishing convention papers, and how long is an article before it is too long. Plans for the future were given a heavy going over and the guests gave their opinions on ideas for prospective symposia, special issues, and new features.

It wasn't all work and no play at Cherry Valley Ranch. The guests and editors went on early-morning and late-afternoon hunting jaunts into surrounding hills where deer and turkey abound. But better results were obtained around the conference table this year than in the deer blind. Some blamed the scarcity of game on the unseasonable weather. Others said the deer and turkey toms were just smarter than editors and refiners. But one happy hunter was Cleve Lee, whose 5-point buck is shown in the photo.

The conference was a howling success. The guests were generous in both praise and censure and their recommendations will shortly be manifest in better articles for REFINER readers in 1954.

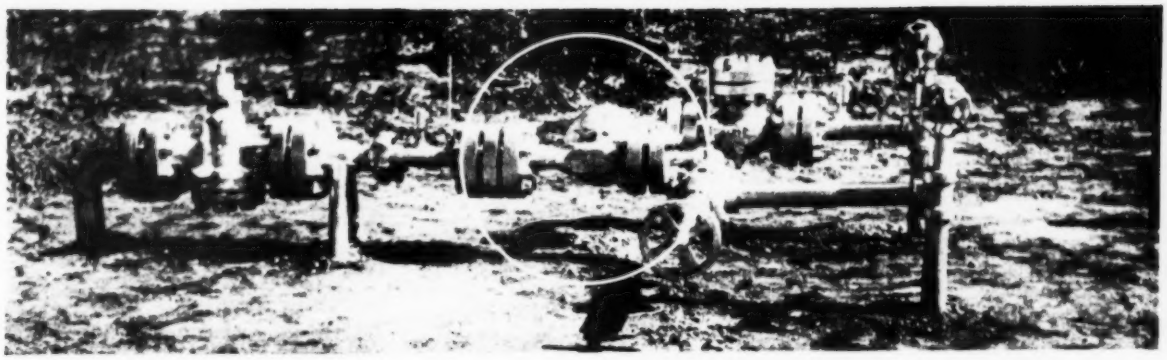


Figure 1. Jet compressor installed on gas wells of Chicago Corporation near Kingsville, Texas. The compressor is circled in the photograph.

Put high-pressure gas to work with . . .

Gas Jet Compressors

Low cost, no moving parts, simple to maintain; gas jet compressors can use the energy in high-pressure gas to compress low-pressure gas.

George R. Fletcher, Worthington Corporation, Harrison, N. J.

GAS JET COMPRESSORS can use the energy stored in high-pressure gas to compress low-pressure gas. In many instances, their use offers remarkable economies for the pipe line and refining industries.

The gas jet compressor is the newest addition to the family of devices which includes perfume atomizers, paint sprayers, automobile carburetors in which a gas at a suitable velocity is forced past a small opening, sucking into the gas stream the perfume, paint or gasoline.

As can be seen in Figure 2 the gas jet compressor is an exceptionally simple device consisting of only four parts: A suction chamber, a nozzle extension, a nozzle, and a diffuser.

In operation when gas at high pressure is allowed to expand freely through a converging diverging nozzle with very smooth walls to a lower pressure the expansion occurs with almost no increase in the entropy of the gas. (For the purpose of this discussion the presence and effect of shock waves occurring where the flow is supersonic will be ignored.) As a result, for any but small pressure drops, the expanded gas discharges from the nozzle at very high velocity and at a temperature very much lower than that of the initial gas temperature.

Velocities of the order of 4000 to 5000 feet per second for steam jet ejectors, the parent of the gas jet compressor, and of 2000 to 3500 feet per second for gas jet compressors are not unusual. Areas adjacent to high velocity flow are usually areas of low pressure. This can be explained kinetically by stating that the surrounding surfaces of the high-velocity jet picks up and carries along those molecules of the surrounding medium which enter the stream due to their normal molecular motion. The loss of these molecules leaves an area partly deficient in molecules, or an area of low pressure. New molecules of the surrounding medium move in and are as quickly entrained by the high-velocity jet, thus creating a flow of the low pressure gas into the jet.

The high-velocity gas jet carrying with it large quantities of entrained low-pressure gas enters the diffuser where the properly shaped passageways convert the velocity energy of the gases into pressure energy somewhat as is done in centrifugal gas compressors. The diffuser is really the heart of the compressor. The success of the jet compressor, the degree of efficiency obtained, lie chiefly in the correctness of the internal contours of the diffuser. It can be seen in Figure 2 that, as in the nozzle, there are converging, then diverging passageways.

Obviously tremendous amounts of energy can be relased when a gas is expanded in a suitably designed nozzle. However, when a gas is throttled, as in a choke, the potential energy is wasted since no useful work is produced in the throttling process. This same wasted energy, if used in a jet compressor, gas expander or similar device, could furnish much useful work of compression.

There are many situations in which it is desired to mix two gas streams, one at high pressure and one at low pressure and end up with a single

stream at some intermediate pressure. A few examples of real or projected installations of this kind will illustrate the possibilities.

A large utility company for years compressed its manufactured gas to a street pressure of about 10 pounds per square inch gauge by means of motor-driven centrifugal compressors. In recent years the company also throttled large quantities of natural gas from a transmission line to the same street pressure, mixing the two gases to maintain a definite British thermal unit value.

When it became necessary to replace the old compressors with new ones capable of higher discharge pressures, a study of gas engine-driven angle compressors, gas expanders and gas jet compressors indicated that gas jet compressors would be able to provide the necessary compression at a considerable saving in initial costs, installation cost and operating costs. The final installation consisted of two parallel sets each of six gas jet compressors. One set has capacity to compress approximately 100 million standard cubic feet per day from a few inches water gauge to about 18 psig, using about 200 million scfd of natural gas at 115 psig as motive gas. The other set, of similar capacity, receives gas discharged from the motor-driven compressors at 9 to 10 pounds gauge and discharges it to pressures up to 25 or 26 psig. This second set of jets is used only when the required street pressure is above 18 psig which is expected to occur less than one percent of the time.

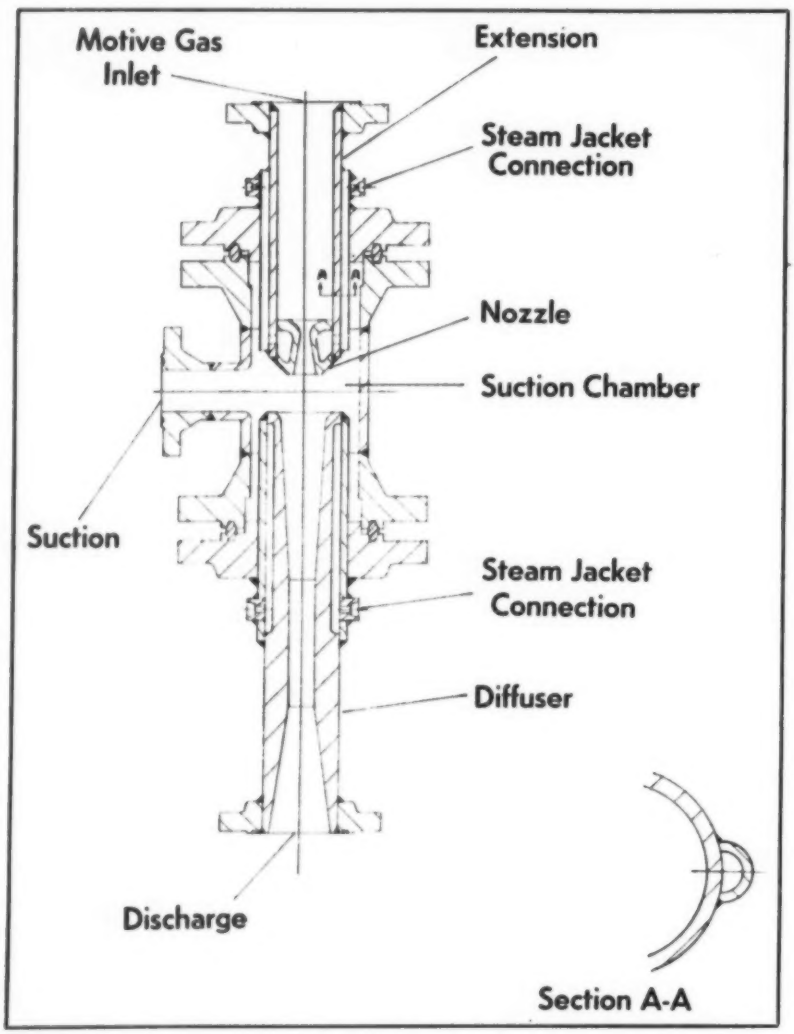


Figure 2. The gas jet compressor is simple in that it consists of only four parts: a suction chamber, a nozzle extension, a nozzle and a diffuser.

The motive energy used in the jet compressors cost the utility company nothing since the natural gas was delivered to it at a pressure even higher than the 115 psig jet compressor design. The cost of operating the 3000-horsepower motor drive of the centrifugal compressor became a clear saving.

Another use of a gas jet compressor was made by an oil and gas producing company operating a mechanical compressor, compressing natural gas from 1000 psig to approximately 2800 psig. Some of the 2800 psig gas discharged from the compressor was used as the motive fluid in a gas jet compressor to compress some natural gas at 250 psig into the suction of the same mechanical compressor at 1000 psig. When the gas supply for this jet compressor disappeared, the unit was installed on some gas wells near Kingsville, Texas, for experimental purposes. The installation is shown in Figure 1. The gas jet compressor is the small item in the middle from the triple flange to the next pair of flanges to the right.

Another gas jet compressor installation under discussion is in a recycling plant which has gases at 2000, 1500, 900 and 600 psig. Use of the compressor would be to form a single stream at 1000 psig or higher. Preliminary calculations show that more than sufficient energy is available from the two higher pressure gases for the compression.

In another installation 500 psig natural gas was used in a gas jet compressor to remove refinery gases from a trap at 5 psig and compress it to 50 psig. Also a small gas jet compressor is being built to compress gas leaking from the seals of a centrifugal compressor into the suction of the centrifugal compressor. Gas discharged by the centrifugal compressor is used as motive fluid. Other examples can be given, but the afore-

Figure 3. Ice formation leaving compressor nozzle and entering the diffuser of an unheated compressor.

Figure 4. Same nozzle and diffuser shown in Figure 3, but with a heated nozzle to prevent ice formation. Note the build-up on the unheated diffuser.

mentioned should be sufficient to illustrate the variety of situations in which jet compressor has potential use.

Gas jet compressors are inexpensive especially when compared to other types of compressors. For example, a single unit to compress 10 million scfd from 600 psig to 800 or 900 psig would cost less than $5000. When multiple duplicate units are used the cost per unit drops appreciably, since design and engineering charges form a large part of the cost of this equipment.

Installation costs are likewise very low. No building, heavy foundation or other protection is required. Under most circumstances the jet compressors can be treated almost like a flanged tee in a pipe line. They must, however, be accessible for periodic inspection.

Under normal circumstances this equipment requires almost no servicing or maintenance, particularly if constructed of suitable materials. For use with sweet, dry natural gas for continuous service, carbon steel is satisfactory. Where the gases are wet and sour and the use will be intermittent or on standby service, alloy construction is required.

To partly balance these apparently overwhelming advantages, the gas jet compressor is not an efficient device. Entrainment, a basic ingredient in the mechanism of the jet compressor, is an inefficient process. In addition, a large part of the energy available from the expansion of the motive gas must be used in recompressing the motive gas back up to the discharge pressure. The over-all efficiency is usually of the order of 20 percent.

This relatively low efficiency limits the number of situations in which the jet compressor can be used. However, when high efficiency is not mandatory, the great advantages of low cost and low maintenance inherent in these devices are worth considering.

It was mentioned above that the expansion of the high-pressure gas in the nozzle occurred almost isentropically and that as a result the gas discharging at high velocity from the nozzle was at a very low temperature. Even steam initially at 300° to 400° F when expanded to a pressure below 0.18" Hg. absolute will turn partly into ice. Such an ice formation is shown in Figure 3, leaving an ejector nozzle and entering the diffuser.

Such ice formations occur in gas jet compressors and interfere with its operation, although since the quantity of condensible material present in most gases is less than in steam, . . . the amount of solids formed is also less. Temperatures are so low at the tip of the nozzle, however, that hydrates or other solids do form in sufficient quantity to interfere with the jet operation.

Heating the motive gas will prevent formation of solids but this is a rather expensive procedure. If the tip of the nozzle and the inlet to the diffuser are heated sufficiently to prevent the solids that do form from sticking and building up, satisfactory operation can be obtained. Steam jackets provided by the manufacturer are commonly used for this purpose. Only a small quantity of 10 or 15 psig steam is required. In Figure 4, the same nozzle and diffuser in Figure 3 are shown but with the nozzle heated, in this case electrically. Note the ice build-up on the unheated diffuser. The typical construction for steam jacketing both nozzle and diffuser of a gas jet compressor is shown in Figure 2.

A performance curve for a gas jet compressor can be established by maintaining the motive gas pressure at the pressure for which it was de-

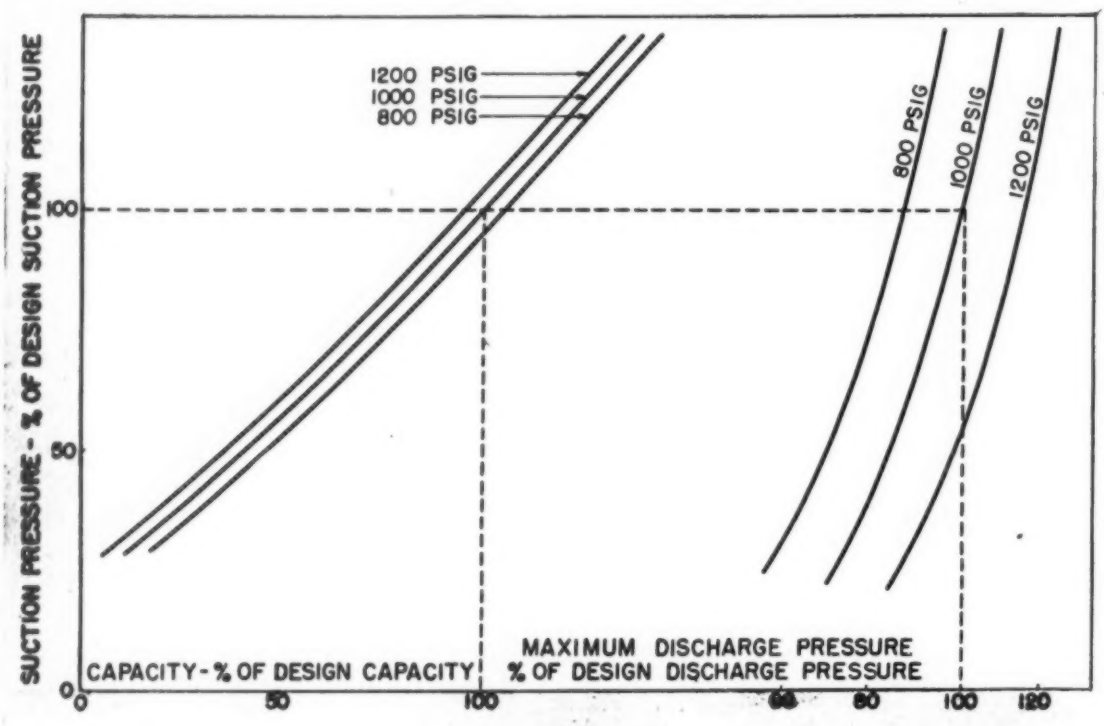


Figure 5. At left are the curves formed by plotting the suction gas flow against suction pressure curves. At right are the curves of the points of maximum back pressure determined at several suction flows.

signed by varying the suction gas flow and measuring the resulting pressure at the suction. By plotting the suction gas flow against suction pressure, curves of the shape as shown at left in Figure 5 are obtained.

As long as the motive pressure is maintained constant and a discharge pressure is not imposed higher than that which the jet can pump against, this curve will be reproduced. Should the suction pressure drop, the capacity, or suction gas flow, drops in accordance with this curve. If in this test a constant motive pressure and suction flow is maintained and the valve on the discharge line is slowly closed, the jet pressure will maintain constant suction pressure until some critical discharge pressure is reached. Any further increase in discharge pressure will be accompanied by an increase in suction pressure. The discharge pressure at which this occurs is called the "maximum back pressure." If this point of maximum back pressure is determined at several suction flows, a curve of these points can be plotted as shown at right in Figure 5.

For example these curves are labeled as 1000 psig motive pressure. To illustrate the effect of a change in motive pressure, another set of curves can be drawn labeled 1200 psig, and a third set can be established, labeled 800 psig. From these curves it can be seen that for a jet compressor to do its job, the motive gas pressure must not fall below the design value unless the pressure against which the jet is discharging is correspondingly lower than the design value. Also, the pressure against which the jet is discharging should not be increased above the design value without also increasing the motive gas pressure.

Note that since the motive gas enters the unit through a nozzle, or orifice, the motive gas flow will vary directly as the absolute pressure of the motive gas.

Although gas jet compressors are capable of high compression ratios, the efficiency falls off very rapidly as the compression ratio increases, or to put it another way, the pounds of motive gas required to compress one pound of suction gas increases rapidly. As a general rule, therefore, the jet compressor finds its chief applications at compression ratios less than three. However, where the quantity of high-pressure motive gas is available, higher compression ratios can be and have been obtained.

Figure 6, showing four sets of curves, has been prepared to give some idea of how much high-pressure gas is required to compress gas of the same density to several discharge pressures. A jet compressor can be built for any of the values read from the curves, but these are not perform-

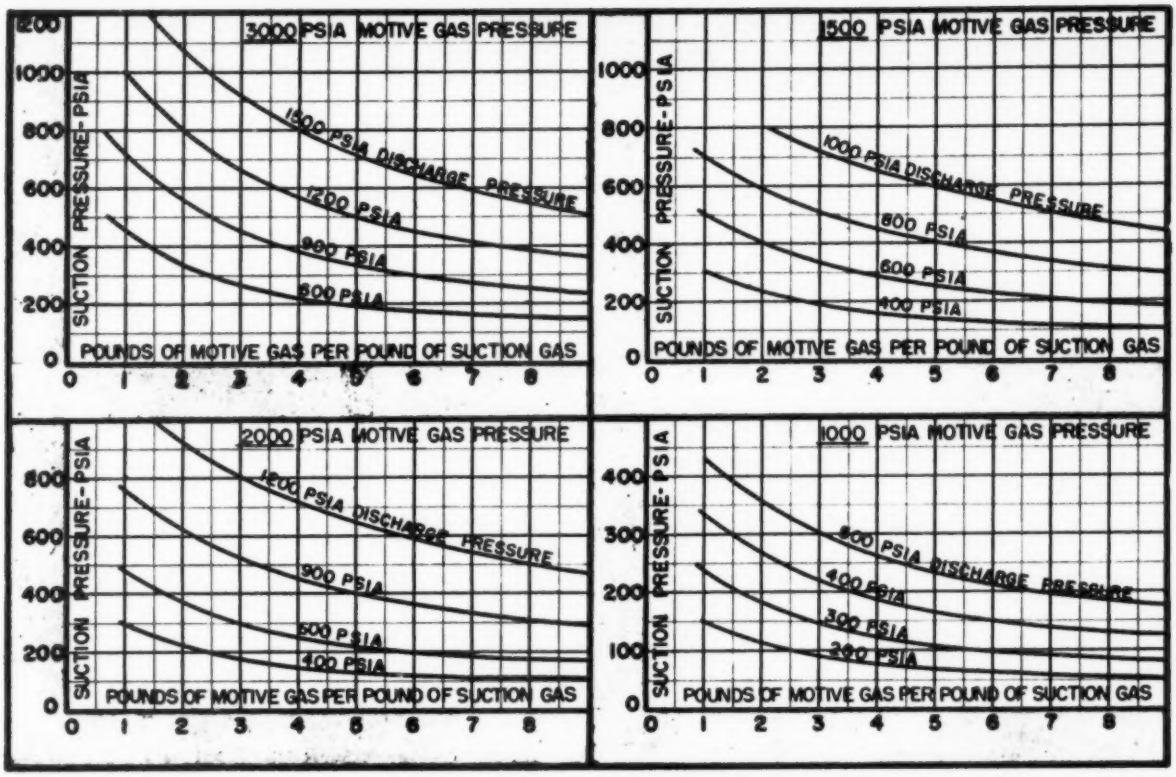


Figure 6. These four sets of curves have been prepared to give an idea of how much high pressure gas is required to compress gas of the same density to several discharge pressures. When the density of the motive gas and the suction gas are the same, the pound per pound ratio read from the curves exactly equals the ratio of the volume of motive gas per volume of suction gas.

ance curves of a unit.

The extra energy obtainable from higher motive gas pressures can be found by determining the number of pounds of motive gas required for a similar compression for several motive pressures. For example, in compressing from 200 pounds per square inch absolute to 400 psia the required pounds of motive gas required per pound of suction gas for 1000, 1500, 2000 and 3000 psia motive pressures are approximately 3.5, 2.7, 2.4, and by a rough extrapolation, 2.0 respectively. (Note use of absolute here.)

These curves are not meant to give exact values but merely to make it possible to determine whether a particular project is within the realm of possibility. When the density of the motive gas and suction gas are the same, the pound per pound ratio read from the curves exactly equals the ratio of the volume of motive gas per volume of suction gas—*both values being at standard conditions.*

When the density of the two gases differ, a correction must be applied to both the pound per pound ratio as well as the volume per volume ratio. The correction is relatively complicated so that exact values cannot be presented here, however, an approximate value can be obtained as follows:

To obtain the corrected value of the pounds of motive per pound of suction gas divide the value of the pounds per pound from the curves by the square root of the density of the suction gas over the density of the motive gas. If the density of the suction gas is one-half that of the motive gas, divide the pounds per pound value from the curves by the square root of one-half, or approximately 0.71.

The corrected volume per volume ratio would be the pound per pound ratio read from the curves (not the corrected pound per pound ratio) multiplied by the square root of the suction gas density over the motive gas density. For the example given before, the volume per volume ratio would be equal to the pound per pound ratio from the curves multiplied by 0.71.

In determining the possibility of applying a gas jet compressor to a particular set of conditions, the following information is necessary and should be supplied to the manufacturer:

- Lowest motive gas pressure expected;
- If natural gas, the density or molecular weight;
- If other than natural gas, the molar composition;
- Mixture gas temperature and expected variation;
- Maximum quantity available for use in jet (specify quantity as standard cubic feet daily);
- Suction pressure;
- Suction gas quantity to be compressed (scfd);
- Suction gas density or molecular weight;
- Suction gas temperature;
- Desired discharge pressure;
- Some description of proposed application;
- Is part load operation desirable.

Now in operation . . .

Second Ammonia Plant for Shell

New ammonia plant located near Ventura oil field for natural gas supply.

Oversized mufflers on these engine compressors reduce noise to minimum.

ANHYDROUS AMMONIA has started flowing from Shell Chemical Corporation's new plant at Ventura, Calif. The plant cost approximately $10,000,000. Utilizing a process first demonstrated in Germany 40 years ago, methane is reacted with stream and air under high temperature in a gas reforming unit. The hydrogen-nitrogen mixture obtained is then purified before going into the final reaction step for combination to ammonia.

The plant will have a productive capacity of 150 tons a day. Together with Shell Chemical's ammonia plant at Pittsburg, Calif., it maintains Shell's position as the largest producer of anhydrous ammonia and ammonium sulphate west of the Rockies.

The bulk of Shell's ammonia production is earmarked for western agriculture, whose use of ammonia has increased remarkably in recent years. In 1942, the Rocky Mountain and Pacific Coast states used a total of 382,266 tons of fertilizer—in 1952, the farmers of California alone used 750,000 tons.

The 27-acre plant site three miles north of downtown Ventura was chosen because of the rapidly growing demand for ammonia fertilizer in California and Arizona and because Shell Oil Company's operations in the Ventura oil field offer an ample supply of natural gas needed in the manufacturing process without interference with other industrial and domestic uses.

Frank D. Kuenzly, formerly superintendent of the Pittsburg plant, will be manager of the new plant where about 140 persons will be employed. A native of Colfax, Calif., Kuenzly received a degree in chemistry from the University of California at Berkeley. He joined Shell at Pittsburg in 1931 and has served also at San Francisco and Dominguez, Calif., and at Dumas and Houston, Texas.

Ammonia's most important application is as a fertilizer. The Ventura plant will also produce ammonia for use in industry for refrigeration, and the manufacture of synthetic fibers, explosives, pulp and nitric acid.

The most effective methods of applying ammonia as a fertilizer were first developed by Shell in the 30's and have been widely used since then in other parts of the country. These methods are part of Shell's trademarked nitrogation and nitrojection services which are respectively methods of transmitting ammonia to the soil through irrigation water and direct injection. Through these services all Shell agricultural ammonia sold to the farmer is applied by trained distributors from company-owned containers.

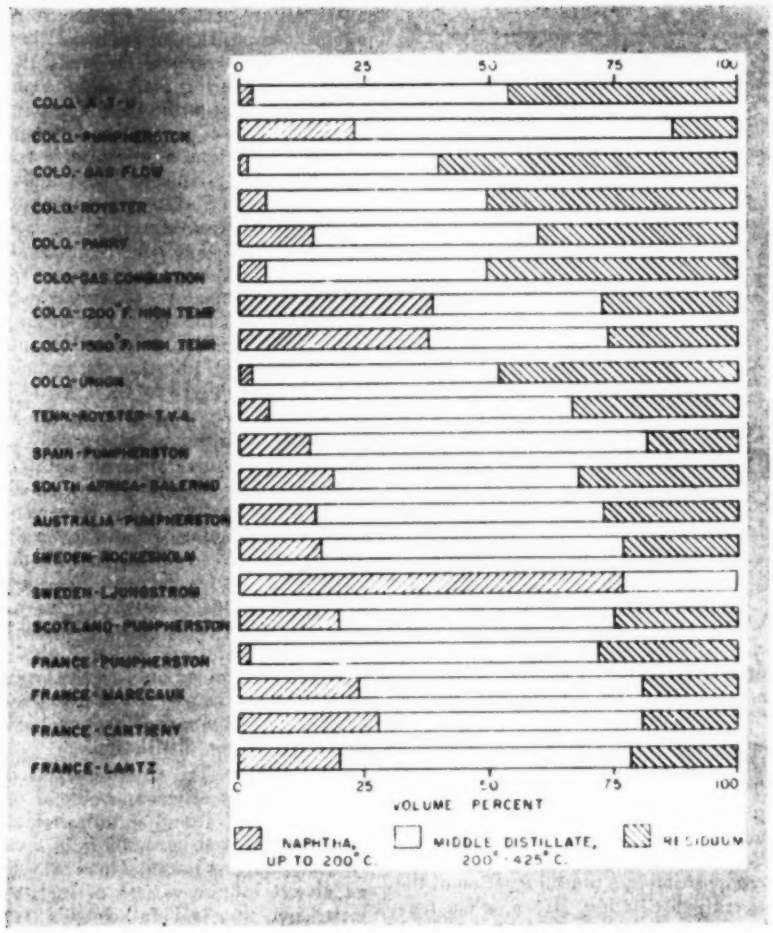


Figure 1. Distillation summary for crude shale oils.

Shale Oil—What Is It?

Analyses of ten U. S. and ten foreign shale oils yield a comparison with crude petroleum.

G. U. Dinneen, Bureau of Mines, Laramie, Wyo.

SHALE OIL is a potential source of large quantities of liquid fuels. This simple statement provokes a multitude of economic and technical questions. The present article will discuss one of the most fundamental of these—what is shale oil? The discussion will be based on the results of laboratory analyses at the Laramie Station of the Bureau of Mines on ten shale oils produced in the United States by different methods of retorting and on ten oils from commercial-scale operations in six foreign countries.* Under the general topic the discussion will cover such specific questions as: Are shale oil and petroleum, the present source of liquid fuels, practically the same? Do shale oils as a class have identifying characteristics? How much variation in composition is there among shale oils? What factors affect its composition?

Shale oil is produced from the solid organic matter occurring in oil shale by heating it to a temperature of about 900 F. or higher. The crude shale oil thus produced resembles petroleum in that it is composed of hydrocarbons plus sulfur-, nitrogen-, and oxygen-derivatives of hydrocarbons. However, it differs markedly from petroleum in that the nonhydrocarbons are present to a much greater extent. This is particularly evident in the higher boiling fractions in which, in the case of shale oil, they may be the major constituents. In addition, the hydrocarbons of shale oil show a much lower degree of saturation (hydrogen content) than those of petroleum because of the pyrolytic origin of shale oil.

The 20 oils analyzed have, as would be expected from the preceding paragraph, certain features that may be considered characteristic of shale oils. Owing to the necessity of using temperatures of 900 F. or higher in their production, all of the oils contain large quantities of unsaturated and aromatic hydrocarbons. Also, all of the oils have appreciable quantities of sulfur, nitrogen, and oxygen-containing compounds. However, in these as well as other properties, the oils show a wide range of values. Consequently, the characteristics of each oil must be determined individually.

Some major variations in composition can be correlated with the source of the oil shale and the temperature used to convert it to oil.[1] The sulfur and nitrogen contents seem to depend primarily on the source of the shale from which the oil was obtained. At low retorting temperatures the shale source also has an important effect on hydrocarbon composition of the oil, but an increase in retorting temperature increases the aromaticity of the oil until an oil coasisting almost entirely of aromatic compounds can be obtained.

The method used for shale-oil analysis is adapted from the well-known Bureau of Mines routine method for analyzing crude petroleum,[4] so only a brief description, primarily emphasiz-

* A copy of the complete report of this work can be obtained free by requesting Report of Investigations 4898, Analysis of Crude Shale Oil by R. F. Stevens, G. U. Dinneen, and John S. Ball, from the Publications Distribution Section, U. S. Bureau of Mines, 4800 Forbes Street, Pittsburgh, Pennsylvania.

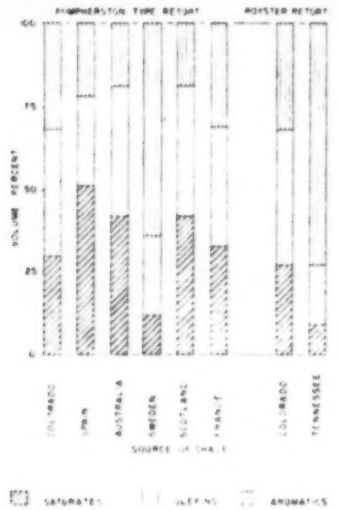


Figure 2. Hydrocarbon composition of distillate boiling below 315 C.

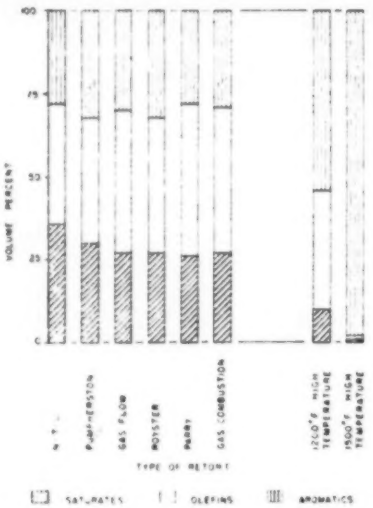


Figure 3. Composition of distillate boiling below 315 C. from Colorado shale oil.

ing the modifications necessary for its application to shale oil,[3] will be given. The significant modifications provide for the apparent poor heat stability of shale oil; determination of the hydrocarbon composition, particularly olefin content, of the lower boiling distillates; and determination of the distribution of nitrogen with respect to boiling point.

Experimental—The procedure may be considered conveniently under the following divisions: Dehydration of the crude shale oil and determination of properties of the dried oil, distillation of the sample first at atmospheric pressure and then at reduced pressure, and analysis of fractions from the distillation.

Shale oil as produced contains water that must be removed before a satisfactory distillation can be made. As part of the water is often present as a stable emulsion, a system for drying by heating usually gives the best results. The properties determined on the dried oil are specific gravity, sulfur and nitrogen contents, pour point, and viscosity.

Distillation of the sample is made on a 300-ml charge to give 14 fractions and a residuum. The first seven fractions are obtained at a pressure of about 760 mm of mercury. They are taken at 25 C. intervals to a final vapor temperature of 200 C. The other seven fractions are obtained at 25 C. intervals under a reduced pressure of 40 mm to a final vapor temperature of 300 C. The principal difference in this procedure from the petroleum method is in stopping the atmospheric distillation at 200 C. instead of continuing to 275 C. During distillation of crude shale oil, visual observation sometimes indicates cracking below a vapor temperature of 275 C. Although the extent of decomposition may not be great, it is undesirable to risk any decomposition in a central fraction of the overall distillation. Hence, a cut temperature of 200 C. was selected both because it is well below decomposition temperatures and because the total atmospheric distillate is then approximately equivalent to the gasoline fraction. The vacuum distillation is carried to 300 C. to obtain the maximum amount of distillate without severe decomposition. A brief investigation of the heat stability of shale oil was made under conditions similar to those in the analytical method, using gas production as a criterion of decomposition. The results showed that only small quantities of gas were produced below a liquid temperature of 375 C., which corresponded to a vapor temperature of about 310 C.

The volume and specific gravity are obtained on each of the 14 fractions from the distillation to give the boiling-range distribution of the sample and a material balance for the operation. Each of the fractions is composed principally of saturated, olefinic, and aromatic hydrocarbons, together with smaller amounts of sulfur, nitrogen, and oxygen-containing compounds. Correlations based on simple physical properties are unsuitable for determining the composition of such complex materials. Extraction of tar acids and tar bases by aqueous reagents followed by an adsorption method for determining hydrocarbon groups is the most reliable technique now available for analyzing such mixtures.[2] These analyses are made on volumetric composites prepared from fractions 1 to 7 (naphtha) and 8 to 10 (light distillate), as rather large samples are required. Unfortunately, these methods are not applicable to higher-boiling distillates, so aniline point and viscosity are used for indicating the composition of fractions 11 to 14.

Shale oils always contain substantial quantities of sulfur and nitrogen, so distribution of these elements with respect to boiling range was investigated. It was found that the sulfur content of each of the fractions from a given oil was about the same as that of the crude oil itself. On the other hand, the nitrogen contents of the fractions increased greatly with increase in boiling point. Therefore, in the analysis, sulfur is determined only on the crude shale oil, but nitrogen is determined also on the composite fractions and residue from the distillation.

Discussion—The usual method of obtaining shale oil from the solid organic material found in oil shale is by heating it to at least 900 F. in some type of retorting vessel. There may be an almost infinite variety of such retorts, but they all fall into a few classes based on the fundamental factor of the method used to transfer heat to the shale. The most important classes are: Heat transferred to the shale through a wall; heat transferred to the shale from combustion gases generated in the retort; and heat transferred to the shale by passing previously heated gases through the shale bed. One of the oils analyzed was produced by the Swedish Ljungstrom process, which belongs to none of these classifications. This process utilizes tubular electric heaters placed in boreholes in the shale at regular intervals to heat the oil shale in the ground. The volatile pyrolysis products are collected through other holes drilled into the shale for this purpose.

The temperature required in the retorting process results in shale oil containing substantial quantities of unsaturated hydrocarbons in addition to the saturated and aromatic compounds usually found in petroleum. Also, shale oils contain from a few tenths to several weight-percent each of sulfur, nitrogen, and oxygen. Thus shale oils not only differ from petroleum but, because of the many types of compounds they contain, have an oppor-

tunity for large differences among themselves.

One of the more important characteristics of an oil determined in the analytical scheme is the boiling-range distribution. Figure 1 summarizes such data for the 20 oils in terms of two distillate fractions and a residuum. Although grouping the data into these large divisions eliminates much of the variation, it demonstrates graphically that major differences exist among the oils. It is evident from the figure that in any group there are variations amounting to several hundred percent based on the lowest value shown. Exclusive of the oil from the Ljungstrom process, the oils have naphtha contents ranging from 2 to 40 percent and residuum values of 12 to 60 percent. These differences appear to be due to a combination of retorting variables, including temperature, residence time, and efficiency of recovery.

Differences in the oils are evident also in their compositions. For example, the lower-boiling distillates from the oils vary from materials containing over 50 percent saturates and/or nearly 50 percent olefins to those consisting essentially of aromatics. The major variations in composition can be correlated with the primary variables, shale source and retorting temperature.

The importance of shale source can be shown from differences in composition of oils produced in the same type of retort from different shales or from similarities in composition of oils produced in different retorts from the same shale. The results for the 20 oils analyzed provided data for both of these approaches. Pumpherston-type retorts, in which heat is transferred to the shale through a wall, were used to produce oils from shale obtained in six different countries. The hydrocarbon composition of distillate boiling below 315 C. from each of the six oils is shown in Figure 2. The wide range of composition indicates the important effect of shale source. The large difference in composition of the other two oils shown in Figure 2, which were produced from Colorado and Tennessee shales in the Royster retort, also demonstrates this effect.

The second approach to determining the effect of shale source on composition is to compare oils produced from the same shale in different retorts. At the left in Figure 3 are distillates from six oils produced from Colorado shale. The marked similarity in composition of these as compared to the differences among those shown in Figure 2 also indicates that shale source may play an important part in composition of oil.

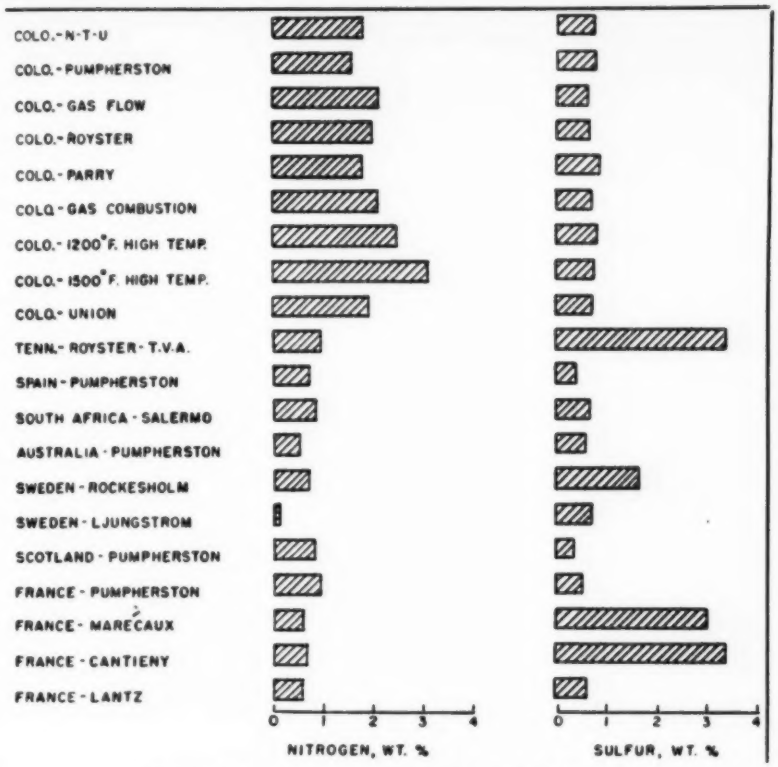


Figure 4. Nitrogen and sulfur contents of crude shale oils.

All oils discussed so far were produced in retorts that presumably operate at temperatures only slightly above those necessary for decomposition of the organic material in the shale. Hence, temperature probably was not a significant variable that affected composition. The two oils at the right in Figure 3 were produced from Colorado shale in a retort designed to heat shale of small particle size rapidly at a controlled temperature higher than that normally employed. The extraordinary effect of these higher temperatures in increasing the aromaticity of the oil produced is evident.

The relatively high contents of nitrogen and sulfur in shale oils are often considered to present the most serious obstacles to economical refining. The data in Figure 4, which shows the nitrogen and sulfur contents of the 20 crude shale oils, indicate that the magnitude of these problems depends primarily on the shale source as retorting appears to have relatively little effect. All of the United States oils were from Colorado shale except the last (Royster-TVA), which was from Tennessee shale. All of the nitrogen contents of the oils from Colorado shale are similar and much higher than those of any of the other oils, the average being somewhat over twice the highest of the foreign oils. Also, all of the Colorado oils have similar sulfur contents that are about midway in the range shown by the other oils. The effect of source of shale is particularly evident in the oils from Colorado and Tennessee shales, both produced in Royster retorts. The Tennessee oil has only about half the nitrogen content but five times the sulfur content of the Colorado oil.

Summary The composition of crude shale oil as determined by a relatively simple laboratory method of analysis is described. The particular characteristics of shale oil considered in selecting the method are discussed. An abstract of results obtained by applying the method to ten oils from the United States and ten oils from six foreign countries is presented. The general composition of shale oils and the effect of shale source and retorting temperature on composition are discussed.

LITERATURE CITED

[1] Dinneen, G. U., Ball, John S., and Thorne, H. M., Ind. Eng. Chem., **44**, 2632 (1952).
[2] Dinneen, G. U., Smith, J. R., and Ball, John S., Pet. Refiner, **29**, 129 (May, 1950).
[3] Stevens, R. F., Dinneen, G. U., and Ball, John S., Bureau of Mines Report of Investigations 4898, 1952. 20 pp.
[4] Wenger, W. J., and Ball, John S., Bureau of Mines Report of Investigations 4517, 1949. 9 pp.

Safe and inexpensive device to . . .

Speed Spectroscopic Analyses

This original device affords effective means of cleaning glass sample containers by:

◗ Cutting washing time 80 percent ◗ Effectively removing contaminants

◗ Eliminating contact with hazardous cleaning chemicals

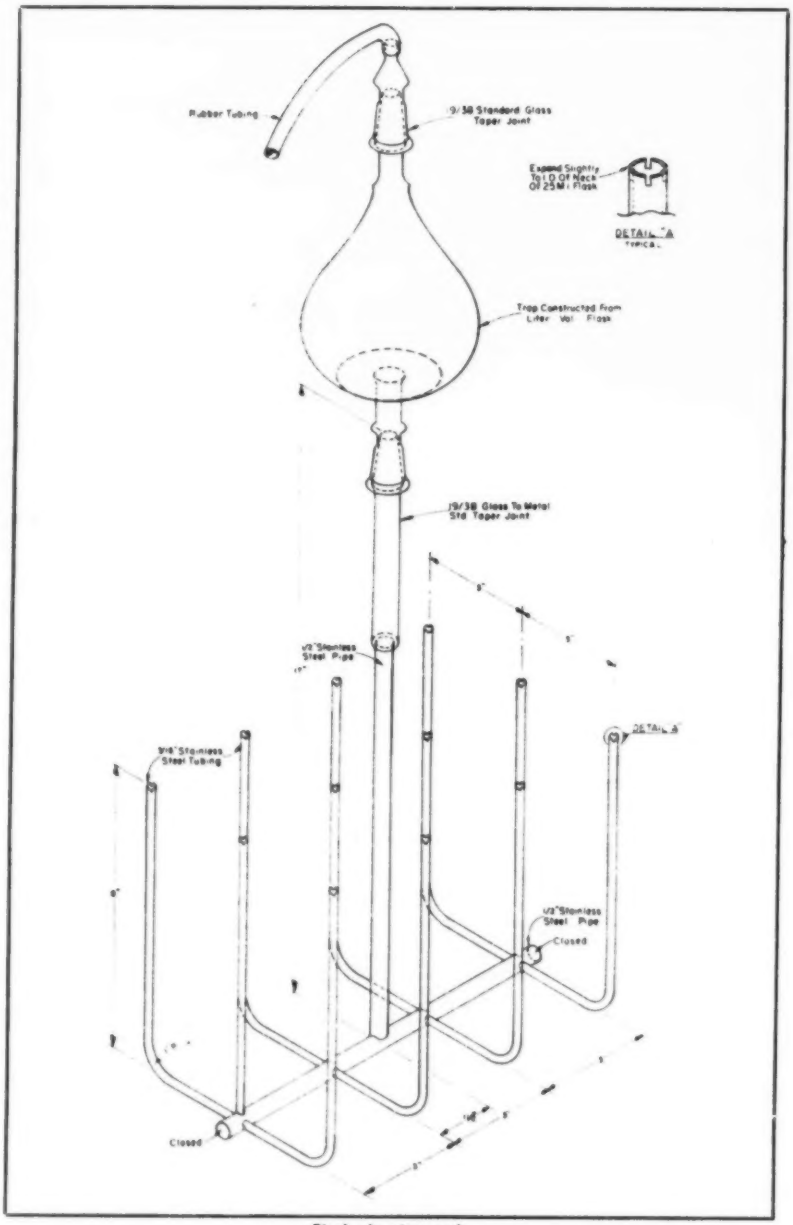
John H. Jordan, Jr.,
Magnolia Petroleum Company,
Beaumont, Texas

THE RAPID advancements made in spectrometric and colorimetric analysis have presented a problem in maintaining clean glassware, particularly small volumetric flasks, for this work. Much care must be taken in cleaning glassware for this use to avoid contamination, which usually means that each flask must be cleaned individually by the tedious and time-consuming operation of contacting with a cleaning solution and rinsing under a water faucet.

The apparatus shown in the figure washes spectrometrically clean 12 volumetric flasks simultaneously, requiring less than two minutes of the operator's time. The unique feature of the washer is the manner in which the 12 flasks are contacted inside and outside simultaneously with cleaning solution.

The washer is constructed of glass and stainless steel or copper for use with sulfuric acid-dichromate cleaning solution. A stainless steel tank 9 x 12 inches x 12 inches deep with cover is placed in or near a sink. The tank contains the cleaning solution in which the flasks are immersed.

Flasks to be washed are inverted on the 12 tubes. As the flasks are lowered into the cleaning solution, a slightly reduced pressure is applied at the trap. This reduced pressure evacuates the air from the flasks thus filling them with cleaning solution. It has been found convenient, before immersing the flasks, to open the vacuum line and as the flasks are immersed, control the flow of cleaning solution into them by pinching the rubber tubing joining the trap. The trap is disconnected at the standard taper joints. Although not necessary, the application of a slight pressure at the metal joint speeds the flow of cleaning solution from the flasks as the apparatus is withdrawn. The washer is placed in a sink for the flasks to be rinsed with water. The rubber tubing is attached to a water line and the outsides of the flasks are rinsed momentarily before attaching the glass joint to the metal joint for rinsing the insides of the flasks automatically.



Flask cleaning rack

Obviously, similar glassware such as 4-oz. bottles and milk test bottles can be cleaned with the washer.

ACKNOWLEDGMENT

The author wishes to thank the Magnolia Petroleum Company for permission to publish this article.

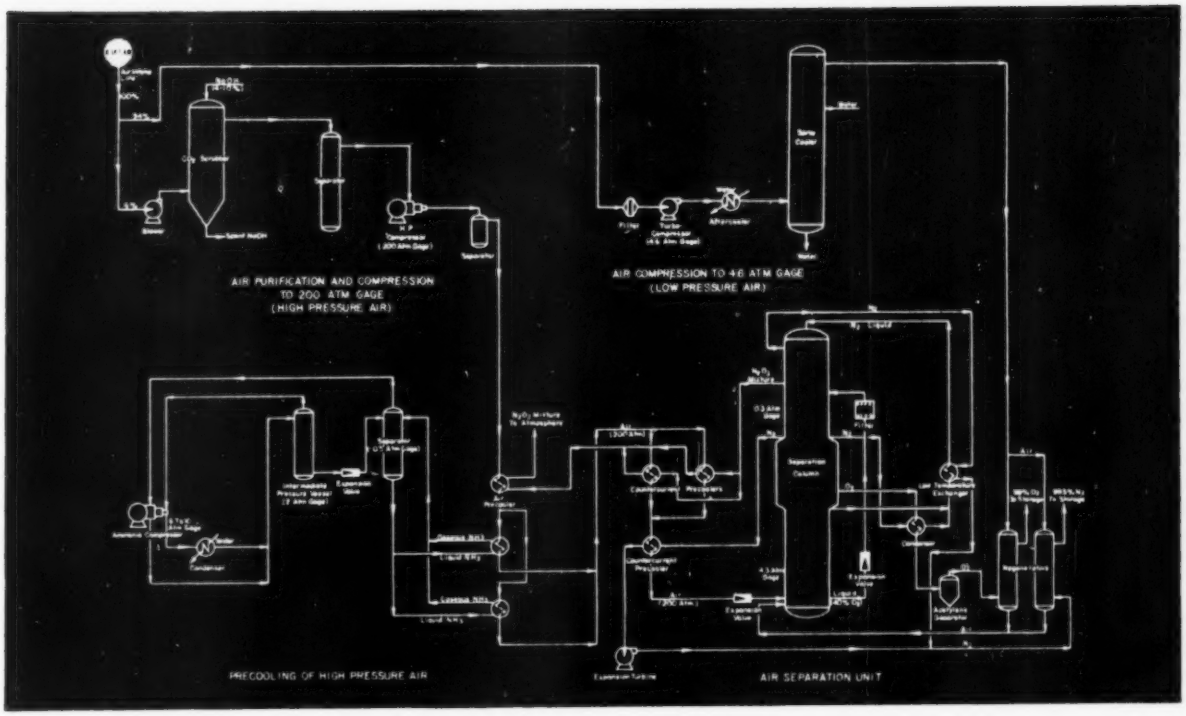

AIR PURIFICATION AND COMPRESSION
TO 200 ATM GAGE
(HIGH PRESSURE AIR)
AIR COMPRESSION TO 4-6 ATM GAGE
(LOW PRESSURE AIR)
PRECOOLING OF HIGH PRESSURE AIR
AIR SEPARATION UNIT

Figure 1. Original Linde-Frankl I cycle.

An auxiliary to petrochemical processing . . .

Tonnage Oxygen

Part I. Rectification and Refrigeration

Part II. Heat Exchange Methods and Impurities Removal

Part III. "Package" Units.

Peter W. Sherwood, Chemical Engineer
White Plains, N. Y.

THE FIRST TWO sections of this series discussed the chief operations involved in an oxygen cycle, the different tools which have been developed to implement each operation successfully, and thermodynamic considerations which must be satisfied in the design of an operable and efficient process for the production of tonnage oxygen.

The following discussion of existing processes will be confined to major types of cycle which are available today as "package" units. All of these have been proven in commercial practice or, at least, in pilot plant operation on an adequate scale. Each of these cycles offers some advantages and is beset by specific limitations. With one or two exceptions, they may be considered economically competitive for most installations.

The Linde-Frankl I Cycle This is the oldest useful tonnage oxygen cycle. It is the basis, in various modifications for numerous commercial installations.

The original version of the Linde-Frankl I cycle (See Figure 1) calls for a main air stream at lower-column pressure (4.5-6.5 atmospheres) and an auxiliary stream of air which serves to supply needed refrigeration and to provide "unbalance" flow in the heat exchangers. This auxiliary air stream must be freed of water and carbon dioxide by external means.

The main air stream, which constitutes 94-96 percent of the total intake, is filtered and is then boosted to 5.6 atmospheres in a turbo-compressor.

After water-cooling, it is passed directly to a set of Frankl regenerators, in which it is cooled to —155 C. About 20 percent of the incoming air is passed through the oxygen exchanger; the remainder is taken through the nitrogen unit. The air stream leaving the bottom of the Frankl regenerators enters the lower section of a double-column at a point directly above the bottom plate.

Between 4 and 6 percent of the air intake is handled as a separate stream up to the point of rectification. It is first scrubbed with an aqueous caustic solution (4-10 percent) for the removal of carbon dioxide. The washed air is then compressed to 200 atmospheres. It is now subcooled to —130 C. in a succession of four stages. The first step takes the temperature to 10 C. A readily available cooling medium for this stage is an effluent mixture of oxygen and nitrogen which is withdrawn from the column, and which has already given up most of its sensible "cold" in the third precooling stage for the auxiliary air stream.

Two heat exchangers are provided to lower the temperature of the high-pressure stream from 10 to — 35 C. An external refrigerant (ammonia, freon) provides the necessary cooling effect.

The third stage, which also operates with a set of duplicate heat exchangers, provides cooling to —70 C. In this operation, the cooling medium is a mixture of nitrogen and 15-20 percent oxygen which is withdrawn from the upper part of the double column.

Final cooling of the auxiliary air stream to —130 C. is accomplished in heat exchange with gaseous nitrogen withdrawn from the top of the high-pressure column. Following this heat exchange function the nitrogen stream (which contains 0.5 percent oxygen) passes to the bottom of the Frankl regenerators where it is joined by the main nitrogen product stream.

So forecooled, the high-pressure air stream is expanded through a nozzle into the lower section of the double column which it enters in liquid form.

The operation of the double column has been described in some detail in the first part of this series. There is no significant deviation in the Linde-Frankl I cycle. The upper column is operated at 1.3 atmospheres absolute. Transfer streams from lower to upper section are 96 percent nitrogen and 40 percent oxygen, respectively. The latter is filtered in the course of transfer and may be passed through silica gel (for acetylene removal).

Nitrogen, leaving the top of the upper column at —190 C. serves to liquefy high-pressure nitrogen en route from the lower to the upper column section. In this exchange function, the product nitrogen stream is warmed to —160 C., at which temperature it enters the bottom of the Frankl regenerators.

Product oxygen leaves the bottom of the upper column in 98 percent purity. It too, serves to precool nitrogen reflux to the upper column (in an auxiliary condenser which has been considered in connection with the acetylene problem in Part II). The oxygen stream enters the bottom of the smaller Frankl regenerators at —150 C.

Both product streams, upon issuing from the top of the Frankl heat exchangers, pass directly to the product gas holders.

It will be noted that about 4 percent of the total air volume is rejected as an argon-rich stream containing some 15-20 percent oxygen without ever passing through the heat accumulators. This amount is approximately equal to the subsidiary high-pressure air provided in the cycle. Another 4 percent of the air volume handled is lost from the regenerators in the course of valve reversal. Thus, the mass "unbalance" provided in the regenerators amounts to a net total of only about 4 percent.

Much criticism has been leveled against the complicating aspects of the cycle's high-pressure stream. With the advent of efficient turbo-expanders, it has now become possible to cover all or most of the cycle's refrigeration requirements by this means. Several cycles (e.g. Kellogg, Linde-Frankl II) have chosen the route of compressing the entire air feed to a single (low) pressure. In others (Oxyton, Air Reduction Company), refrigeration by expansion in a turbine is supplemented by Joule-Thomson throttling of a high pressure stream which, however, may now be operated at 10-20 atmospheres (vs. 150-200 atm. in the original Linde-Frankl I cycle).

Strong arguments may be put forth in support of either method. The most significant consideration in elimination of the high-pressure air stream is, of course, the simplification which it permits in the entire process flow. However, the retention of some high-pressure air adds significantly to the flexibility of the process.

The Oxyton Cycle—The main air stream, compressed to 5.5 atmospheres, follows the same route outlined above for the Linde-Frankl I cycle and enters, after passage through a set of Frankl regenerators, into the high-pressure column. The auxiliary air stream is boosted to about 10 atmospheres (a similar cycle due to Ges. Fur Linde's Eismaschinen operates this circuit at 20 atmospheres). It is freed of carbon dioxide by chemical means and of moisture by external refrigeration. To cool the high-pressure air stream to pre-expansion temperature, it is passed through a heat exchanger in exchange with nitrogen withdrawn from the top of the high-pressure column.

Having fulfilled its cooling function (and having thereby been adequately pre-warmed), this nitrogen stream is expanded into the regenerators via a turbo-expander. It enters the turbine at 5.0 atmospheres and —158 C., and leaves it at 1.3 atmospheres and —190.5 C. Interposed between the turbine and the heat accumulators is a tubular heat exchanger which serves to liquefy part of the feed streams from the high-pressure to the medium-pressure column.

This medium-pressure column is part of the three-column system which is characteristic of the Oxyton and Air Reduction Company cycles. It has been touched upon in the discussion of rectification systems.

The low-pressure (1.3 atm.) and high-pressure (5.5 atm.) columns are superimposed on each other in the manner of the normal double column. The main condenser-vaporizer is in its customary place between the two columns. However, a third, medium-pressure (2.5 atm.) column is interposed into the flow of nitrogen and oxygen concentrate from lower to upper column.

The medium-pressure tower is set parallel to the double-column system. The oxygen-rich stream in its bottom is vaporized in heat exchange with nitrogen-rich fraction in the center of the high-pressure column. An intermediate condenser-vaporizer is provided in the latter for this purpose, adding enriching reflux to the lower section. Oxygen concentrate is vaporized at upper-column pressure outside the tubes of the medium-pressure column's reflux condenser.

Over-all flow in the column system is as follows: Air enters the high-pressure column where it is separated into nitrogen (overhead) and a 40 percent oxygen concentrate in the bottoms. The main condenser-vaporizer provides the lower column with a nitrogen reflux amounting to 45 moles per 100 moles air fed to the system. Additional reflux is provided in the lower section by virtue of the intermediate vaporizer referred to in the preceding paragraph.

About 30 percent of the lower column's nitrogen make serves to pre-

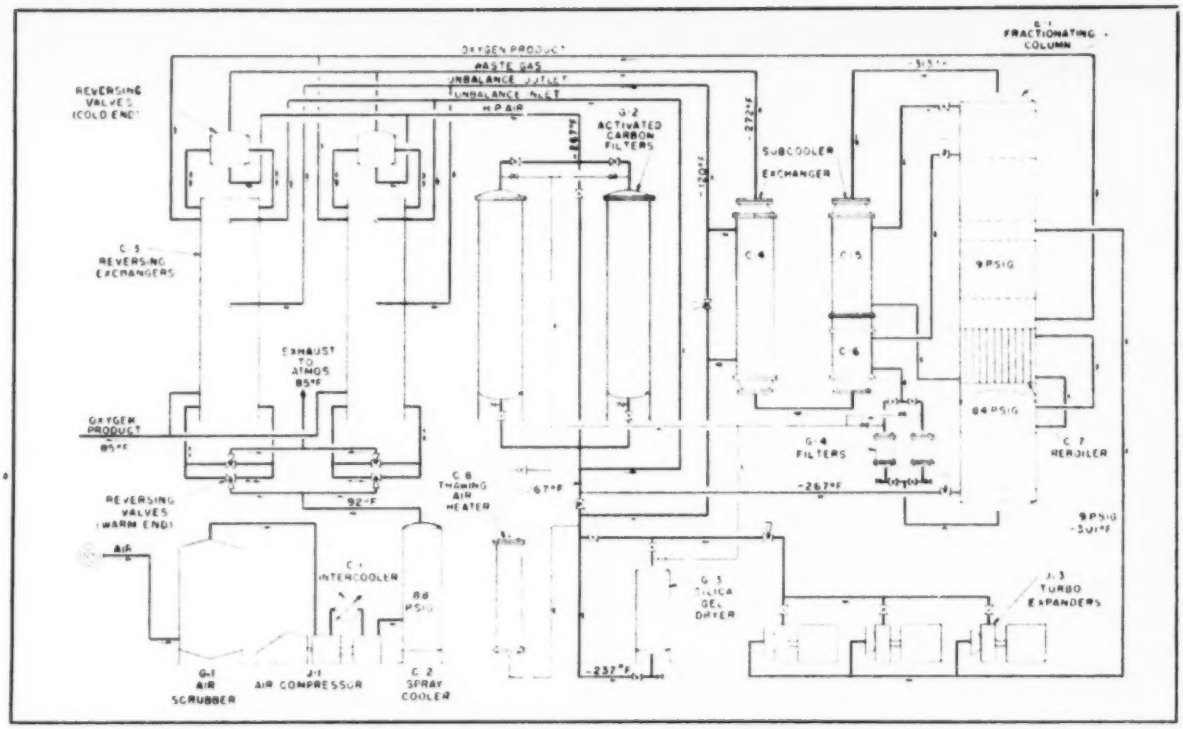


Figure 2. Kellogg Oxygen Cycle. Courtesy: The M. W. Kellogg Company.

cool the high-pressure air (see above) and is then cooled by turbo-expansion en route to the heat accumulators. The remaining 70 percent is liquefied in an auxiliary condenser (in exchange with product oxygen leaving the low-pressure column). This liquefied nitrogen stream serves as reflux to the upper (low-pressure) tower.

The oxygen concentrate leaving the high-pressure column is subcooled by a nitrogen stream. It is then flashed into the central section of the medium-pressure column.

In this column, a 55 percent oxygen concentrate is formed which is flashed into the medium-pressure tower's reflux condenser shell where it is partially vaporized. This stream is finally fed to the low-pressure column as a mixed phase. Nitrogen make of the intermediate tower serves as reflux to the upper column.

Product oxygen leaves the bottom of the upper column. Nitrogen is withdrawn from the top of this tower. The flow of these streams through a succession of heat exchangers and accumulators differs only insignificantly from that of the Linde-Frankl I cycle.

Processes which operate only with low-pressure (5.5-6.5 atm.) air rely for all or most of their refrigeration on the turbo-expansion of pre-cooled air into the *upper* column. This different point of entry is a significant variation. It reduces the amount of reflux available in both columns. Typical of this method of operation are two processes, which differ radically from each other in certain other aspects: The Kellogg cycle, and the Linde-Frankl II cycle.

The Kellogg Cycle—Figure 2 shows a flow sheet of this process. The entire intake air is compressed to 6.2 atms. abs. and is passed through an oxidation catalyst (for destruction of acetylene and other hydrocarbons) while still hot from compression. It is then cooled by means of water.

After water separation, the air stream enters one set of passages of the Kellogg-Collins reversing heat exchanger. Characteristics of this unit have been considered in some detail in Part II of this article series. The stream of air, leaving the heat exchangers at —168 C, is passed through activated charcoal filters for the removal of unconverted residual hydrocarbons. (This and other precautionary measures against entry of acetylene into the low temperature system is, of course, not an inherent characteristic of any specific oxygen cycle.) To provide necessary "thermal unbalance," a portion of the cooled air is returned through another pass in the heat exchanger in accordance with the Trumpler system which has also been previously explained.

In the Trumpler pass, the unbalance air stream is reheated from —168 to 84 C. A separate heat exchanger is provided in which product nitrogen serves to reduce the temperature of this stream below —129 C.

Unbalance air is now joined with a part of the main stream in proper ratio to give a mix temperature of 153 C. which is suitable for efficient turbo-expansion. The expanded gas leaves the turbine at 1.5 atms. and —187 C., i.e. at approximately its saturation point. In this condition it is fed to the upper section of a double-column system. In the Kellogg cycle, the amount of Lachmann air provided in this fashion constitutes about 26-30 percent of the total intake.

The main air stream (totaling 70-74 percent of the intake) enters the lower half of the double column directly from the regenerative heat exchangers. (Only a protective activated charcoal filter is interposed). Feed conditions to the lower column are 5.9 atms. and —168 C. Separation in the double-column takes place in accordance with standard practice.

Product oxygen is withdrawn from the bottom space of the upper column at —180 C. and is fed directly to the oxygen passage of the Kellogg-Collins heat exchange where it is reheated to ambient temperature. Nitrogen, which leaves the upper column at —191 C., serves to subcool the nitrogen and oxygen concentrate passing from the

high-pressure to the low-pressure tower. Its final heat exchange function, before entering the reversing heat exchanger, is to subcool the unbalance air stream from —84 to below —129 C.

It has been pointed out that high-pressure air shows special advantages at times of start-up and overload for many reasons. Since the Kellogg cycle operates without such an auxiliary air circuit, two to three turbo-expanders are provided, although only one is needed for normal operating conditions. The spare units serve to cool the unit down and to build up liquid inventory.

The Linde-Frankl II Cycle—This process, illustrated in Figure 3, contains for the most part elements which have already been discussed in connection with the Linde-Frankl I and the Kellogg cycles.

Regenerative heat accumulators and a double column are employed. However, no high-pressure air cycle is provided. Instead, about 15-20 percent of the intake air is withdrawn from an intermediate point of the heat accumulators. This stream is devoid of water but must be freed of unremoved carbon dioxide by adsorptive means. It is then expanded through a turbine into the upper tower of a double-column. The main stream of air continues through the remainder of the heat exchangers and enters the lower column in the usual fashion.

Wucherer[3] reports that this version of the cycle calls for duplicate heat exchangers to permit fairly frequent deriming in the light of high incidence of fouling by carbon dioxide.

This difficulty has apparently been largely overcome by the development of an inexpensive regenerator packing which is provided in the cold end of the accumulator.

If this filling is employed, unbalance air may be withdrawn from the cold end of the regenerators and returned as a Trumpler pass through its proper tubular passages in heat exchange with incoming air. This Trumpler air is expanded through a turbine into the upper column, i.e., the air flow pattern is akin to that described above for the Kellogg cycle.

With this new packing improved, the amount of unbalance air must, of course, be increased. Wucherer[3] speaks of a stream equivalent to 25 percent of the intake air.

According to Blaw-Knox Company,[4] the new type of packing makes it possible to extend the regenerator switching cycle from its normal 2-4 minutes to 15 minutes, with consequent saving in compressed air and improved product purity.

The Elliott Cycle—With a discussion of the Elliott cycle, we enter a totally different concept of tonnage oxygen production. Whereas in all of the foregoing cycles air expansion serves for the bulk of refrigeration requirements, and a double column must therefore be used, the Elliott process relies on an external refrigerant, namely nitrogen. This makes it possible to maintain the air stream at substantially atmospheric pressure throughout the entire cycle, and to employ a compound column (which is of simpler construction and more flexible than the Linde double-column). However, this process does not, of course, avoid the use of work-consuming compression. In this cycle, an external nitrogen stream is boosted to high pressures.

A further peculiarity of the Elliott process is the use of indirect, non-reversing heat exchangers of the Elliott-Modine finned design. Use of these units (which have been described in Part II of this series) eliminates the need for an unbalance air stream. On the other hand, it makes frequent deriming necessary (at four-hour intervals) and therefore calls for space heat exchangers and introduces an external source of "cold" loss.

The Elliott cycle is illustrated in Figure 4.[5] Air is boosted to 1.4 atm. abs. and is precooled to +5 C. by means of freon, and dried to a dew point of —40 C. by silica gel adsorption.

The air stream is now fed to one of the four heat exchangers (Unit "D" in the flow sheet), where its temperature is reduced to —188 C. in heat exchange with nitrogen withdrawn from the top of the rectifying column. A temperature differential of 5-6 C. is maintained in the heat exchanger (note that this is possible without unbalance because, in the Elliott cycle, the air feed is at substantially the same pressure as the product streams). Upon leaving the heat exchanger, air is fed to an intermediate plate of the fractionation column.

Nitrogen leaving the warm end of Heat Exchanger "D" is split into two streams. One part serves to derime one of the heat exchangers by passing from through its nitrogen passage toward the cold end and then returning to the warm and via the air passage. This nitrogen stream, having completed its cleaning function, may be mixed with the main nitrogen product stream. Each heat exchanger is derimed in its turn for 15 minutes out of every four hours. In the flow sheet, exchanger "C" is off-stream for this purpose.

A second portion of the nitrogen stream leaving exchanger "D" is not used for cleaning and is partly drawn into the compressors of the refrigerant cycle and partly delivered as product.

Now return attention to the air stream which has entered the fractionating column where it is separated into its components (at 1.25 atms. Frictional pressure drop accounts for this difference from booster outlet pressure).

Nitrogen, leaving the top of the column, is split into two streams. One passes to heat exchanger "D" as outlined above. The remainder passes to the nitrogen compressor. En route it serves to cool high-pressure nitrogen in the following order: (a) Subcooling of liquid high-presssure nitrogen on its way from the column reboiler

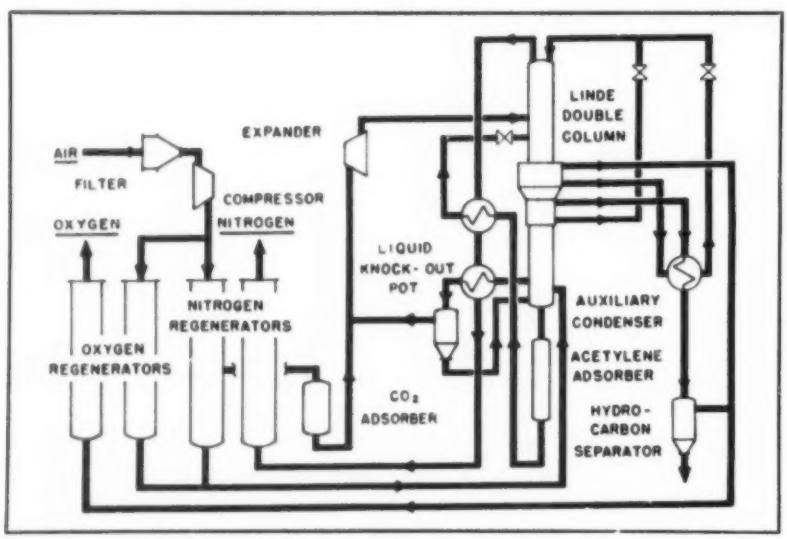


Figure 3. Linde-Frankl II cycle.

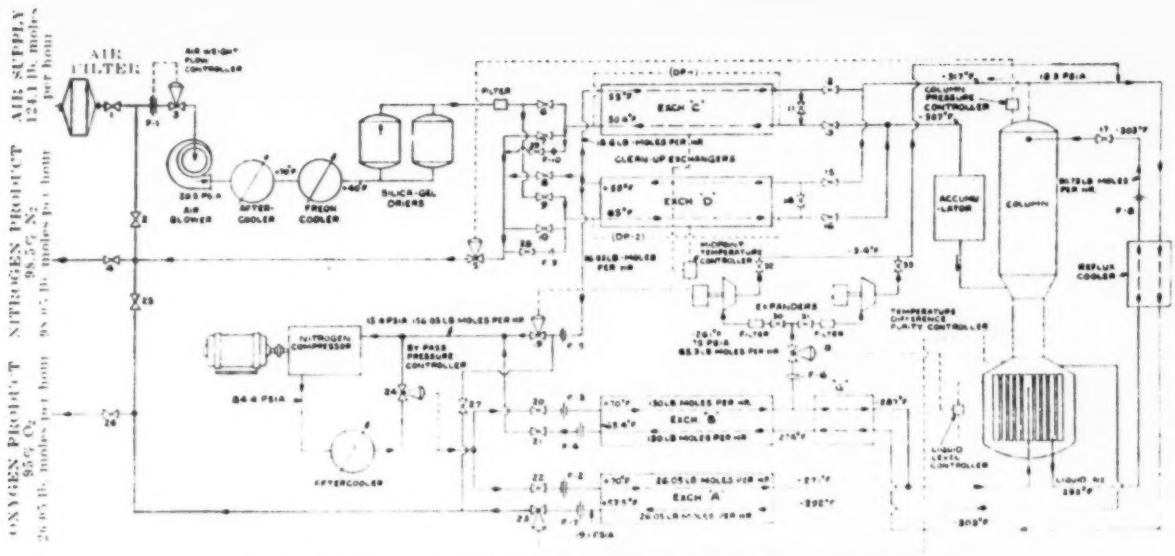


Figure 4. Elliott oxygen unit, pilot plant. Courtesy: "Industrial and Engineering Chemistry."

to be expanded into the column top as reflux liquid. (b) High-pressure gaseous nitrogen on its way from the compressor to the column reboiler.

Oxygen is withdrawn from the column bottoms in the vapor state and is warmed to almost ambient temperature in heat-exchange with incoming high-pressure nitrogen. An Elliott-Modine unit serves in this function. Nitrogen fed to the compressor by the routes indicated above, is boosted to 5.75 atms. Following standard after-cooling by water, this high-pressure nitrogen is subcooled in exchangers "A" and "B" plus "G" as shown in the flow sheet. This stream is fed to the column reboiler tubes where it is liquefied in exchange with evaporating oxygen.

A portion of the high-pressure nitrogen stream is withdrawn at a point between exchangers "B" and "G" where it is at −164 C. a suitable feed temperature for turbo-expansion. Leaving the expanders at −192 C., this stream is mixed with column overhead to provide sufficient low-temperature cooling for the reflux nitrogen passing from the high-pressure reboiler tubes to the low-pressure column top.

TABLE 1
COMPARISON OF DIFFERENT CYCLES

Treated Air Quantity, 20,000 cubic meters per hour; Oxygen Purity, 95 percent; Oxygen Quantity, 120-145 tons daily. Efficiency of Turbo-compressors, 57 percent in relation to Isothermic Compression.

	Linde-Frankl I with Regenerators and Additional Air and Turbo-Expansion	Air Reduction with Regenerators. Add. Air and 3 Columns	Kellogg Company "Reversing Exchangers" Without Add. Air	Elliott Company Automatic "Reversing Exchangers" with Nitrogen Circuit	B.O.C. "Rescol" Regenerators with Nitrogen Circuit
Atmospheric Test, percent	98.5	96.6[1]	96.5[1]	99.5[1]	99.5[2]
Switching Leakage, percent	4	4	2		4
Produced Oxygen, Quantity cub.m. per Hour	4,000	3,620	3,730	4,310	4,150
Low Pressure Air					
Quantity, Cub.m.per Hour	20,000	20,000	20,000	20,000	20,000
Pressure Atm. Abs.	5.5	5.5	6.4 (7.3)	1.55	2.5
Power Consumption, kw.	1,638	1,638	1,782 (1,902)	429	764
Additional Air					
Quantity, Cub.m.per Hour	800	500[2]			
Pressures, Ats. Abs.	20	6.5			
Power Consumption, kw	55	3			
Nitrogen Circuit					
Quantity, Cub.m per Hour				20,000[4] (26,000)	15,000[2]
Pressure, Ats. Abs.				6.5	5.5
Power Consumption, kw				1,790 (2,330)	1,162
Turbo-Expander					
Quantity, Cub.m per Hour	4,000	I Stage II 8,000 4,000	5,920[3]	11,300	20,000
Refrigeration, kcal.per Hour	35,400	18,600 17,100	43,800	95,500	68,000
Power Recovery, kw	37	35	46	100	71
Refrigeration Compressor					
Refrigeration, kcal.per Hour	10,000			110,000	
Power Consumption, kw	8			200	
Total Power Consumption, kw	1,664	1,696	1,736 (1,856)	2,130 (2,670)	1,855
Total Power Consumption, kw-Hr. per cub. m. Oxygen 95 percent	0.416	0.438	0.465 (0.498)	0.495 (0.620)	0.447
Total Quantity Treated, Cub.m.per Hour	20,000	20,000	20,000	40,000 (46,000)	36,000

[1] Appears very low; Stacey Bros. declare 7.3 ats. abs.
[2] Calculated.
[3] Calculated by the refrigeration requirement. Temperature figures in original flowsheet lead to the improbable value of 11,000 cub. m. per hour.
[4] Declared by Elliott.
[5] Calculation of the reflux requirement of the column and of the refrigeration requirement yields at minimum this value.

The Rescol Cycle – The British Oxygen Company, Ltd., has developed a process (dubbed "Rescol") which resembles, in some of its basic aspects, the Elliott cycle (notably in the use of an external nitrogen cycle and of a compound column). Significant points of difference are the use of Frankl regenerators and turbine expansion of the air stream which is compressed to an initial pressure of 2.6 atmospheres.

Briefly, this cycle involves initial compression of air to 2.6 atmospheres. The gas is subcooled in a Frankl regenerator in exchange with nitrogen *only*.

Upon leaving the cold end of the Frankl regenerator, air is expanded into the atmospheric-pressure compound column via a turbo-expander.

As in the Elliott process, reflux is provided by means of a high-pressure (5.5 atm.) nitrogen cycle. Liquefaction of the high-pressure nitrogen occurs mainly in the column reboiler from where the liquid phase is expanded, via a subcooler, into the column top to serve as reflux. A portion of the compressed nitrogen is subcooled in exchange with product oxygen while another portion is cooled by transfer from some of the column overhead which passes directly to the compressor.

Tonnage Oxygen . . .

Adequate refrigeration is provided by the turbo-expansion of air. The nitrogen cycle handles about 750 cubic feet per 1000 cubic feet air fed to the system.

Process Performance Highlights and essential performance data characterizing different cycles are summarized in Table 1, which is due to Wucherer.[3]

Economics of Tonnage Oxygen Production—Suitability of tonnage oxygen for petrochemical operations is in the last analysis, a question of dollars and cents. This means the cost of carrying out a chemical conversion by the use of oxygen as compared to alternate schemes which may be available for the desired conversion.

In any economic evaluation involving these alternates, the cost of producing oxygen is of signal importance. Consideration must also be given to the continuity of oxygen production, for a temporary shutdown of the oxygen facilities will force a shutdown of the entire chemical operation.

Much has been written during recent years on tonnage oxygen economics, but actually only a few serious studies have been published. A major item in oxygen production costs are fixed charges, which are significantly related to plant size and accounting basis. Difference in capital cost is also related to the cycle employed, but the extent of this difference has certainly been overrated in many public statements.

The second item of great importance in oxygen economics is the cost of power. This depends, of course, greatly on conditions encountered locally and is significantly related to the size of the plant and the purity of the product.

In large plants (150 tons per day or more) labor costs per unit product tend to become a minor factor. Today's plants are highly instrumented and incremental labor costs are small.

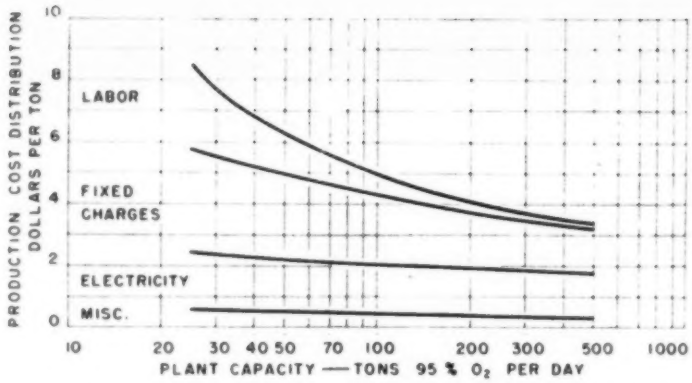


Figure 5. Production cost distribution (Linde-Frankl II cycle). Courtesy: Blaw-Knox Company.

An annual study of the American Gas Association supplies cost estimates furnished by different engineering firms, for capital investment and overall production costs in tonnage oxygen plants of different sizes. In each case, the same basic assumptions as to unit power cost, wages, etc., are made. In the most recent available study, released in 1952,[6] the following chief assumptions were made:

Steam—
$0.40 per M pounds
Cooling Water—
.01 per M gallons
Electricity—
.005 per Kwh
Labor—
Two men per shift, $1.40 per man-hour
Fixed Charge—
10 percent of plant cost per year
Product—
95 percent oxygen, no credit for by-product nitrogen

At these conditions, the costs as shown in Table 2 are reported.

These figures should be used with caution. Actual experience indicates that they are somewhat optimistic. They are of value chiefly in indicating order-of-magnitude trends.

The underlying cost factors are clearly brought out in a study of the economics of the Linde-Frankl II cycle, prepared by Blaw-Knox Company.[4] Cost assumptions are those shown for Table 2.

Reciprocating compressors are preferred for plants up to 100-tons-per-day capacity. Above 200 tons, rotary compressors are generally used. The choice in the intermediate range is not as clear-cut and must be made in the light of local economic conditions.

Power consumption is a function of plant size. This is primarily due to reduced heat leakage (per ton oxygen produced) in large units, but is also related to better mechanical efficiencies as the capacity is increased. The effect is especially pronounced in plants of less than 100 tons per day capacity. Thus, a 25-ton plant consumes some 495 horsepower-hours per ton while plants of 300-500 tons capacity require only 390 horsepower-hours per ton 95 percent oxygen.

Figure 5 summarizes distribution of cost factors incurred in the operation of tonnage oxygen plants of different capacities, based on the Linde-Frankl II cycle.

Another valuable study of tonnage oxygen economics involved in the Elliott process is due to Roberts.[7] Included is a determination of optimum conditions in the various cycle components as well as of optimum oxygen recovery (shown to be 98.5 percent). Here, too, fixed charges and energy costs are by far the most important cost factors.

TABLE 2
COST DATA ON THREE OXYGEN CYCLES

CYCLE	Engineering Firm	Plant Size Tons Day	Approx. Plant Cost (Excl. of Site and Storage) Million of $	Production Cost $ Ton 95% Oxygen
Elliott	Elliott Company (Note: The rights to this cycle are now held by H. K. Ferguson Co.)	50	0.80	9.50
		100	1.25	7.00
		250	2.00	5.50
		500	3.00	4.25
Kellogg	M. W. Kellogg Company	50	0.55	6.60
		100	0.80	4.90
		250	1.40	3.70
		500	2.00	2.80
Linde-Frankl II	Blaw-Knox Company	50	0.50	6.30
		100	0.82	4.95
		250	1.58	3.85
		500	2.60	3.30

BIBLIOGRAPHY

[1] Grunberg, J., Industrial Chemist, Feb., 1950, pp. 61-66.
[2] Lobo, W. E. Chem. Eng. Prog., **1**, 21 ff. (1947).
[3] Wucherer, J., Iron and Coal Trades Review CLIX, 723 ff. (Sept. 23, 1949).
[4] Blaw-Knox Company, The Economics of Tonnage Oxygen Production and Use (June 1, 1951).
[5] Roberts, L., Ind. Eng. Chem., **41**, 2661 (1949). Flow Sheet reprinted by permission of the copyright owner, the American Chemical Society.
[6] Wright, C. C., The Current Status of Oxygen Manufacture, Paper presented to American Gas Association Meeting at New York, N. Y., May 27, 1952.
[7] Roberts, L., Chem. Eng. Prog., **46**, 79-88 (1950).

A new technique for . . .

Pipe Flexibility Calculations

The analysis routine on these calculation forms involves only simple arithmetic and no reference to formulas is required.

R. G. Blick, Brown & Root
Houston.

ARTICLES ON flexibility of piping fall into two types. One emphasizes a classical approach and develops flexibility theory from a rigorous, generalized point of view. The other emphasizes short cut or graphical approaches to specific common cases such as U, L or Z bends in single plane. Unfortunately there are no short cut methods for multi-plane bends with the exception of a few simple cases where elbow flexibilities are neglected. The Mitchell method[6] regrettably contains a fundamental assumption that invalidates its use except for symmetrical cases. While all of them have merit and fill a need, actually there is nothing really "new" in any of the publications on flexibility that have been written in the last decade or two.

This present article is not an exception. The theory is all standard, and not new. All reasonably general methods involve quite a lot of tedious numerical computations. So does the method presented in this article. The principal contribution of this article, is the presentation of a new technique for the actual carrying out of the calculations. All numerical calculations in this method involve just simple arithmetic, and no reference to any formulas whatever is required, other than those implicit in the calculation forms themselves. Extensive training in an involved analysis routine is not required.

Basically, this article presents an analysis scheme on a calculation form that purports to be somewhat more compact, and requires less training, than other analysis methods. There is a simplified form, and a more rigorous form. For those interested, the appendix contains a derivation of the method, based on "integration of slope and deflection" rather than on "Castigliano's Theorem."

The First Form—The new analyst is advised to follow instructions contained on the form (Figure 1) verbatim, and actually carry out each step, in those instructions before proceeding to the next step. The best way to learn the form is to use it once verbatim, making no particular attempt to "understand" it. The form is something like a recipe for baking a cake, except that it is used to assay the flexural adequacy of a piping layout.

This form used in strict accordance with its instructions, cannot be associated with such things as elbow flexibility factors. Nor does it take into account the fact that piping is somewhat more flexible in torsion than in plane-bending. The second problem deals with these special considerations, and the third problem presents a more rigorous form.

The first sample problem on this form is identical to that contained on page 62 of Reference 3. The first step in solving a problem is to sketch it on the form. Then the pipe is arbitrarily marked off into pieces; 15 in this case. The length of each piece is marked adjacent to the piece number, in Column 1. The x, y and z coordinates of each piece are written in Columns 2, 3 and 4. This coordinate is to the middle of the piece for straight pieces, and is to 64 percent of the end of the piece for 90° arcs. When Columns 1, 2, 3 and 4 are filled in, the rest of the form is an arithmetic job of carrying out the operations indicated on the form. Columns 5 through 13 are filled in, and added up to get the sum of each Column. Enter these in the SUM row, and use them in the rest of the form, as indicated by the "coding." For instance, the Figure 1 with a square drawn around it, represents the figure in the "sum" row of Column 1.

The next operations are coded with circles. For example, the letter "a" with a circle around it refers to the figure entered in the space identified by the circle-coded "a." Likewise, the Number 2 coded with a circle refers to the figure in the space so coded. The numerical factor "2" is used once in the form. It precedes the calculations for circle-coded 9. It is identified by an arrow to emphasize that it is simply "two," to avoid error. Once circle-coded figures 9 through 15 are obtained, the problem is virtually solved. The "E" value of the pipe material is entered, the "I" value of the pipe is entered, and the "EI" product (in millions) is computed and entered on the form. The net expansions that the piping layout must accommodate, are then computed or recorded in the little table above the sketch.

The little table above the sketch is handy to compute the amounts of net expansion strain that the piping layout must absorb through flexure. There are three net expansions usually, one each for the x, y and z directions. It should be noted that in using this little table, one assumes that the pipe is still connected to the lower left anchor point or nozzle. The upper right end of the pipe, however, is assumed to have been disconnected from the upper right nozzle or anchor point. The motions of this "freed" end of the pipe, due to expansion of the pipe itself, are entered in the first line of the little table.

The first column is for the motion in the x direction, the second for motion in the y direction, and the third column is for the motion in the z direction. However, the "signs" of the motion are reversed. For instance, if the end of the pipe moves .851 inch in the positive x direction, the figure entered is —.851 inch. The second line is used to account for the movement of the lower left nozzle or anchor point, due to any expansion of the equipment at the lower left end of the pipe. Here again the "signs" should be reversed. The third line of the table accounts for any motion in the nozzle or anchor point at the upper right end of the pipe, due to expansion of the equipment at that end. The correct "sign" for the movement there is retained, however.

The column figures are added together to get the net expansions that the piping must absorb in the x, y and z directions. Essentially what is done, is to find the net movement necessary to bring the freed upper end of the pipe back into contact with the

Column	1	2	3	4	5	6	7	8	9	10	11	12	13
OPERATION / PIECE #	piece length	x dim. middle of piece	y dim. middle of piece	z dim. middle of piece	1 2 / 1000	1 3 / 1000	1 4 / 1000	2 5 / 1000	3 6 / 1000	4 7 / 1000	5 6 / 1000	5 7 / 1000	3 7 / 1000
1	48	0	24	0	0	1.152	0	0	.0276	0	0	0	0
2	48	0	72	0	0	3.456	0	0	.2488	0	0	0	0
3	46	0	120	0	0	5.760	0	0	.6912	0	0	0	0
4	46	0	167	0	0	7.682	0	0	1.1829	0	0	0	0
5	79	18	222	0	1.422	17.538	0	.0256	3.8934	0	2.797	0	0
6	34	67	240	0	2.278	8.160	0	.1526	1.9584	0	.6947	0	0
7	34	101	240	0	3.434	8.160	0	.3468	1.9584	0	.8242	0	0
8	35	135	240	0	4.725	8.400	0	.6379	2.0160	0	1.1340	0	0
9	24	163	240	5	3.912	5.760	.120	.6377	1.3824	.0004	.9389	.0196	.0288
10	50	168	240	40	8.400	12.000	2.000	1.4112	2.8800	.0800	2.0160	.3360	.4800
11	50	168	240	90	8.400	12.000	4.500	1.4112	2.8800	.4050	2.0160	.7560	1.0800
12	51	168	240	140	8.568	12.240	7.140	1.4394	2.9376	.9996	2.0563	1.1995	1.7136
13	79	168	222	198	3.272	17.538	15.642	2.2257	3.8934	3.0911	2.3464	2.6278	3.4725
14	24	168	178	216	4.032	4.272	5.184	.6774	.7604	1.1197	.7177	.8709	.9228
15	22	168	155	216	3.696	3.410	4.752	.6209	.5286	1.0264	.5725	.7983	.7366
16													
17													
18													
19													
20													
21													
22													
23													
24													
25													
26													
27													
28													
29													
30													
SUM	672				62.193	127.528	39.338	25.904	37.339	6.7264	14.0488	6.6082	8.4343

- pipe movement	-.851	-.730	-1.094
- ref end mov't	0	0	0
+ top end mov't	0	0	0
net expansion	Δx = -.851	Δy = -.730	Δz = -1.094

Maximum expansion stresses occur at ends or corners of pipe. Label these points A, B, C etc and check moments at these points in spaces provided below, & stresses by 14 and "expans stress".

| POINT | | | | | | | | | | | | |

upper right nozzle or anchor, after all the expansions have taken place. In this case the net expansions are —.851 in the x direction, —.730 in the y direction, and —1.091 inches in the z direction.

The "E" value of the pipe at its operating temperature is entered as 24.82 million, gotten from properties of material available in the references. The "I" value of the pipe is entered as 160.8, gotten from tables on properties of pipe, for the pipe size and schedule of this example. The EI product in millions is 3991 by multiplication. The computations on the rest of the form find the X force to be —1139 pounds, the Y force to be —790 pounds, and the Z force to be —1198 pounds. The moment around the x axis at the origin is 181,165 inch-pounds, around the y axis at the origin the moment is —44,183 inch-pounds, and the moment around the z axis at the origin is —143,075 inch-pounds.

The upper right part of the form is used to find the stress at several points in the piping layout, so as to pick the largest stress. It is found that this largest stress occurs at point A and is 7861 psi. What is done in this part of the form is to transpose the forces and moments just found for the origin end of the pipe, to various points in the piping layout, so as to find the actual values of the moments in the x, y and z directions at these particular points in the layout. The forces are all the same at every point. The effective resultant moment is found by taking the "square root of the sum of the squares" of the actual moments. Dividing this by the "section modulus" (gotton from tables on properties of pipe) produces the effective value of the expansion stress.

At the lower right of the form are entered data pertaining to the pipe, pressure and temperature, etc. The stresses due to the pressure are computed here and combined with the maximum expansion stress to find the total combined stress. This is compared with the allowabe combined stress to determine whether the piping is adequately flexible. In this case the combined stress is 10,138 psi and the layout is deemed satisfactory. The problem here worked out illustrates the most elementary application of the form, where the form instructions are followed verbatim. The next section of this article shows how to modify the use of the form for inclusion of so-called "flexibility factors."

Modified Use of First Form — This form (Figure 2), as used verbatim, makes no provision for so-called "flexibility factors." Often, use of these elbow or curved pipe flexibility factors will show up a layout to be quite satisfactory, where an analysis not using these factors will indicate the layout to be too stiff. Basically, the "flexibility factor" is a ratio telling how much longer than its actual length a given piece of pipe seems to act insofar as flexure is concerned. It is applied to elbows and curved pipe. The greater the total length of pipe in any layout, the move flexible the layout is, provided the essential shapes of the layouts are the same. Consequently, the greater effective length of an elbow helps make the layout act more flexible.

Where a piping layout is essentially in one plane, or flat, the pieces which are elbows may have their lengths entered as "k" times the actual length in Column 1. This applies only to elbows that lie in the same plane as the main plane of the layout. In conjunction with doing this, it is essential to disregard the flexibility of the runs of pipe normal to the main plane of the layout. The coordinate describing the run of pipe normal to the main plane of the layout should be entered as zero. However, the torsional limberness of these runs may be accounted for by multiplying the length of these runs by 1.3. The k factor for elbows is taken from tables available in some of the references. In the second sample problem, the lengths of pieces 5, 11, and 21 are entered as 960 inches, which is 17 times their actual lengths, since the k factor is 17. Also, Piece 21, the straight length in the y direction, is entered as 1.3 times its actual length, to take advantage of the extra torsional flexibility. The y coordinates are all entered as zero.

The rest of the computations are the same as in the first problem, except that the stress concentration factor "β" is used to multiply the expansion stress for each elbow in the main plane. This shows the maximum expansion stress to be 5504 psi at point C. The maximum combined stress is 6782 psi. At point F, the moments in the x and z directions are computed, using the actual y coordinate of point F. These moments are well on the safe side, since the slight flexure of the vertical run will tend to make the center of the forces in the layout lie somewhat above the main plane of the layout, rather than in the main plane of the layout. By having called all the y coordinates zero, it is automatically assumed that the forces in the layout due to the x and z expansion lie in the main plane of the layout. Actually, the procedure here, of calling all vertical coordinates zero, produces rather accurate results, since in the layout no spring hangers were used, therefore flexure in the vertical plane is inhibited. The device of calling all the y coordinates zero has the effect of inhibiting the vertical flexure, insofar as the computations are concerned. The next section of this article presents a form which handles flexibility factors rigorously.

Second Form — In this form (Figure 3), a more rigorous accounting is made of elbow and torsional factors. This is necessary where the piping is definitely multi-plane and it is only possible to have adequate computational flexibility by utilizing vertical flexure and the extra flexibility effects. In such cases, of course, any extra supports in the system must be spring supports, so as not to inhibit the vertical flexure.

The "basic" flexibility of the system is identical to the first sample problem. However, below this part of the form extra computations are made for each individual plane (X, Y and Z) to account for the extra flexural effects that take place in these planes. It is here necessary to consider the piping as regards separate coordinate planes, since specific flexibility factors usually apply only to flexure in one specific plane. For instance, an elbow is essentially more flexible insofar as effective length is concerned, only for flexure in the plane in which the elbow lies. In using this form, meticulous attention should be applied to the instructions, since these are quite abbreviated. Following through the sample problem should clarify the use of this form.

In filling out the form, below the basic calculations which are identical to the first form, one disposes one's viewpoint to the plane under consideration. For instance, in the "X Plane" block, one looks in the direction of the x coordinate, and considers the piping starting with the first piece and ending with the last. The first piece that has more flexibility in the x plane that one notices is Piece 5. Here, part of the bend is in the direction of the x coordinate. Therefore, 30 percent of the radius is entered as the excess member length, or 15 inches. The y and z coordinates are also entered, in Columns 3 and 4. Column 2 is used to record the fact that a k factor of 1.3 is involved, for convenience in future checking of the calculations. The x following the 1.3 indicates that the 1.3 applies to the part of the piece that extends in the x direction. Next, one notices that pieces 6 through 8 extend in the x direction. Consequently

OPERATION	PIECE #	piece length	x dim. middle of piece	y dim. middle of piece	z dim. middle of piece	5	6	7	8	9	10	11	12	13
	Column	1	2	3	4	1×2 /1000	1×3 /1000	1×4 /1000	2×5 /1000	3×6 /1000	4×7 /1000	2×6 /1000	2×7 /1000	3×7 /1000
	1	50	0	0	25	0	0	1.25	0	0	.031	0	0	0
	2	50	0	0	75	0	0	3.75	0	0	.281	0	0	0
	3	50	0	0	125	0	0	6.25	0	0	.781	0	0	0
	4	54	0	0	177	0	0	9.56	0	0	1.692	0	0	0
	5	960	-13	0	227	-12.48	0	217.92	.162	0	49.468	0	-2.834	0
	6	50	-61	0	240	-3.05	0	12.00	.186	0	2.880	0	-.732	0
	7	50	-111	0	240	-5.55	0	12.00	.616	0	2.880	0	-1.332	0
	8	50	-161	0	240	-8.05	0	12.00	1.296	0	2.880	0	-1.932	0
	9	50	-211	0	240	-10.55	0	12.00	2.226	0	2.880	0	-2.532	0
	10	52	-262	0	240	-13.62	0	12.48	3.568	0	2.995	0	-3.270	0
	11	960	-311	0	253	-298.56	0	242.88	52.852	0	61.449	0	-78.656	0
	12	100	-324	0	326	-32.40	0	32.60	10.498	0	10.678	0	-10.562	0
	13	100	-324	0	426	-32.40	0	42.60	10.498	0	18.148	0	-13.802	0
	14	100	-324	0	526	-32.40	0	52.60	10.498	0	27.668	0	-17.042	0
	15	100	-324	0	626	-32.40	0	62.60	10.498	0	39.188	0	-20.282	0
	16	100	-324	0	726	-32.40	0	72.60	10.498	0	52.708	0	-23.522	0
	17	100	-324	0	826	-32.40	0	82.60	10.498	0	68.228	0	-26.762	0
	18	100	-324	0	926	-32.40	0	92.60	10.498	0	85.748	0	-30.002	0
	19	100	-324	0	1026	-32.40	0	102.60	10.498	0	105.268	0	-33.242	0
	20	52	-324	0	1102	-16.85	0	57.30	5.459	0	63.145	0	-18.569	0
	21	960	-337	0	1151	-323.52	0	1104.96	109.026	0	1271.807	0	-372.375	0
	22	12	-366	0	1164	-4.39	0	13.97	1.607	0	16.261	0	-5.113	0
	23	68	-395	0	1164	-31.25	0	79.15	12.349	0	92.131	0	-31.268	0
	24	40	-408	0	1164	-16.32	0	46.56	6.652	0	54.196	0	-18.724	0
	25													
	26													
	27													
	28													
	29													
	30													
	SUM	4308				1003.35	0	2386.83	319.915	0	2053.341	0	705.693	0

PROCEDURE: Sketch isometric of pipe. This should be dimensioned from the lower/left end of pipe, taken as the reference point or origin. Work in inches. Measurements to the right are "x"; up are "y"; and "z" is "into the paper". Arbitrarily divide the pipe into short numbered pieces– about 4 or 5 for each direction or at least 12 for three plane bends. Enter the piece lengths and coordinates of middle of each piece in cols 1 2 3 & 4 (some coordinates may be negative). Compute cols 5 thru 13 (EXAMPLE: for col 5 1 2 /1000 means multiply fig in col 2 by fig in col 1, for each piece, divide by 1000, and write the ans in space provided on same row.). Then compute the "○" coded operations, using the SUM "□" figure of the respective col wherever "□" figures are indicated. After reaching and computing (14), the "E" of the material and "I" of the pipe should be entered, and the "net expansion" computed in the table above the sketch. The pipe is assumed disconnected from the upper right nozzle, and the movement of this end, due to the expansion of the pipe alone, is entered in the first line, for the x, y & z directions with reversed sign. The movement (if any) of the lower left nozzle is entered on the next line with sign reversed. The movement (if any) of the upper right nozzle is entered on the third line with sign unchanged. These figures are added to get the net expansion for each direction. Proceed from (19), computing the forces and moments that act on the lower left nozzle. Compute expansion stress at several points, following table on upper right of this form, following the scheme indicated in the top block of each column. Figure pressure stresses and max combined stress at center-right of form. Forces, moments and stresses come out in units of : pounds, inch pounds, and psi. (CONVENTION: F & M act on the origin-end of a "rigid bracket" connected to the freed end. F,M, displacements and rotations are in positive and right-hand convention. Relative end-rotation is zero.)

SINGLE AND MULTI-PLANE PIPE EXPANSION-STRESS CALCULATION FORM
(conservative solution)

– pipe movement	+.63	–	-1.79
– ref end mov't	0	–	0
+ top end mov't	0	–	0
net expansion	+.63	–	-1.79

Maximum expansion stresses occur at ends or corners of pipe. Label these points A, B, C etc and check moments at these points in spaces provided below, & stresses by (17) and "expans stress".

EXPANS = .00156" PER INCH.
BASED ON 65°F INSTALLED TEMPERATURE
ALL ELBOWS ARE 36" RADIUS.

SKETCH

POINT	M_x	M_y	M_z	(16) $\sqrt{M_x^2+M_y^2+M_z^2}$ ÷ sect. mod.	expans stress
A	0 0 0 / 0 12495 0 / 0 0 0	0 12495 0 / 0 299 0 / 0 0 0	0 299 0 / 0 0 0 / 0 0 0		124464 ÷161.9 = 769 PSI
B	-240 0 0 / 0 12495 0 / 0 0 0	0 12495 0 / 240 299 0 / 0 0 0	0 299 0 / 71760 0 0 / 0 0 0		196224 ÷161.9 = 1212 PSI
C	-240 0 0 / 0 12495 0 / 0 0 0	324 12495 / 240 299 / 0 0	403380 0 0 / 71760 -324 0 / 0 0 0		207180 ÷161.9 = 1280 PSI
D	1164 0 0 / 0 12495 0 / 0 0 0	324 12495 / 1164 299 / 0 0	403380 0 0 / 348034 -324 0 / 0 0 0		69120 ÷161.9 = 427 PSI
E	1164 0 0 / 0 12495 0 / 0 0 0	408 12495 / 1164 299 / 0 0	507360 0 0 / 348034 -408 0 / 0 0 0		35460 ÷161.9 = 219 PSI
F	1164 0 0 / 66 12495 82170 / 0 0 0	408 12495 / 1164 299 / 0 0	507360 -66 299 19734 / 348034 -408 0 / 0 0 0	4.008899 x 10^{12}	91644 ÷161.9 = 566 PSI

(2) = (5)+(6)+(7) = -.2329
(3) = (5)+(6)+(8) = 0
(4) = (7)+(8)+(9) = .5333
(A) = 319.915
-(B) = -233.624
(C) = 86.225
(D) = 0
-(E) = 0
(F) = "2033.343
-(G) = -1320.003
(H) = 713.340
(J) = 0
-(K) = 0
(L) = 0
(M) = "-909.693
-(N) = 535.427
(P) = -374.266
(Q) = 0
-(R) = 0
(S) = 0
(T) = -86.225
(U) = -799.565
(V) = 713.340
(W) = 0
-(X) = 0
(Y) = 23798
(Z) = 0
(AA) = 0
(BB) = .68342

(C) = 2,032,800
(D) = 0
-(E) = 0
-(F) = 0
(G) = 45,175,000
47,127,000
(H) = 68342
-(J) = 0
(K) = 68342
(L) = 0
(M) = 0
-(N) = -123346
(P) = -123346
(Q) = 61508
-(R) = -23798
(S) = 37710
(T) = 0
(U) = 0
(V) = 570362
-(W) = 570362
(X) = 0
(Y) = 27.5 x 10⁶
(Z) = 1943
(AA) = 53400
(BB) = in Millions

(1) = 93433
(2) = 0
(3) = 220789
(4) = 264222
(5) = 295
(6) = 0
(7) = 0
(8) = 0
(9) = 0
(10) = -77706
(11) = 0
(12) = -1020948
(13) = -1098656
(14) = -1245
(15) = 0
(16) = 1649477
(17) = 2832361
(18) = 124464
(19) = 0
(20) = 0
(21) = 0
(22) = 161.9

TEMP 313°F PRESS 66 PSIG DIA. 24"
CORRODED THICKNESS .310 SCHED 30
MATERIAL ASTM A-106 GRADE B
ALLOWABLE COMBINED STRESS 24000
BASED ON ASA B31.1 · SECT. #3 #6, 40% OF ULT. STR.

HOOP STRESS 2295 (= P D/2t)
LONGITUDINAL STRESS 1278 (= ½ hoop stress)

MAXIMUM EXPANSION STRESS 5504, BASED ON: ("B"=4.30) x 1280 = 5504, AT POINT ____
NOTE: K=1.0 · USED AT ELBOWS IN "J" PLANE. K=1.5 · USED FOR VERTICAL MEMBERS.
MAXIMUM COMBINED STRESS ____ [BASED ON LARGEST OF (MAX EXP STR + LONG. STR) = 6782
OR $\sqrt{(\text{MAX EXP STR})^2 + (\text{HOOP STR})^2}$ = 6066
OR ____]

REMARKS LINE IS EXTREMELY LIMBER.

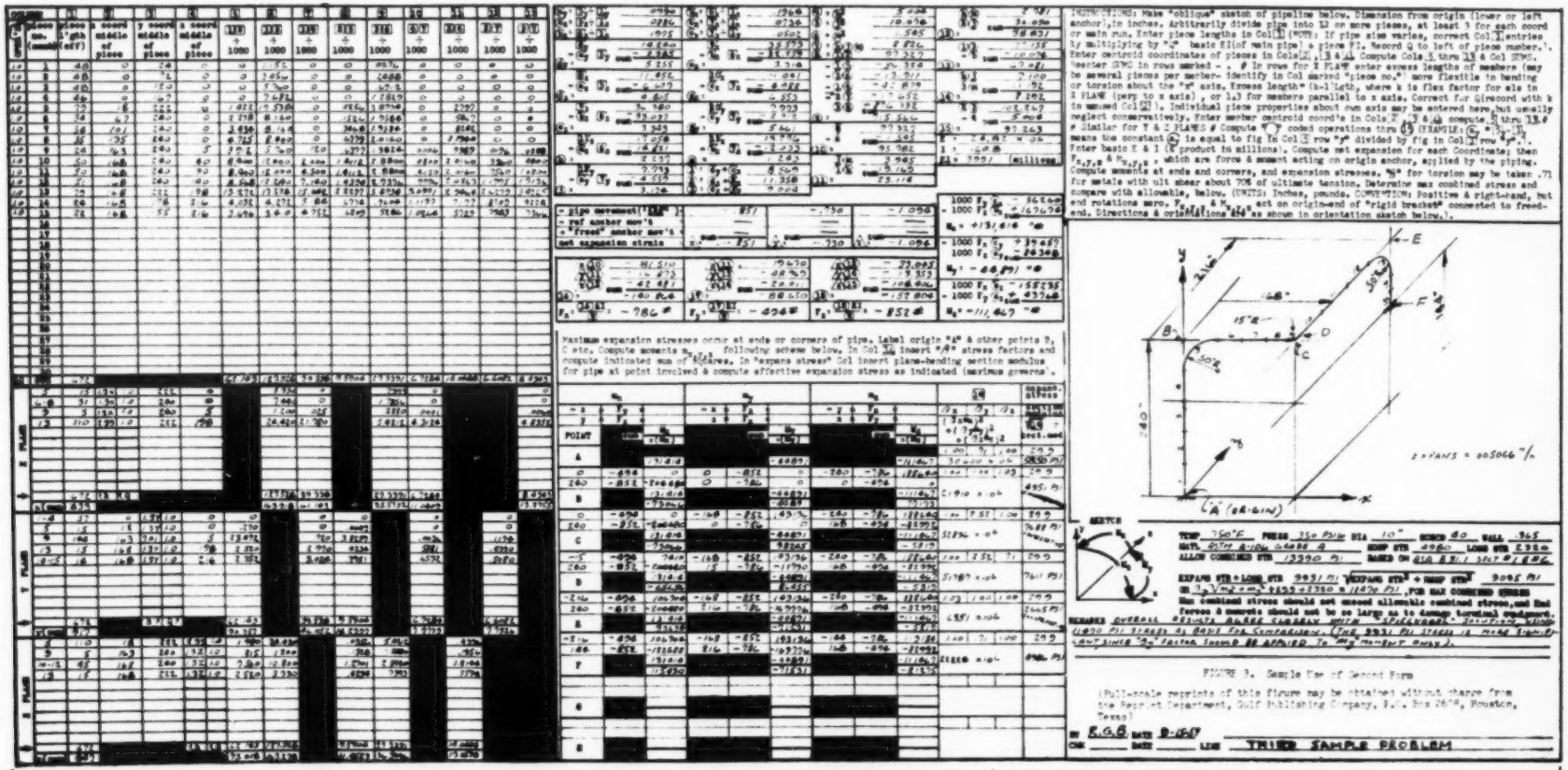
FIGURE 2

BY J.L.E.
DATE 10-6-53
CHECK ____
DATE ____

(SAMPLE OF MODIFIED USE OF FIRST FORM)
LINE # SECOND SAMPLE PROBLEM

Figure 2

Pipe Flexibility Calculations . . .



Full scale reprints of this figure may be obtained without charge from the Reprint Department, Gulf Publishing Company, Post Office Box 2608, Houston 1, Texas.

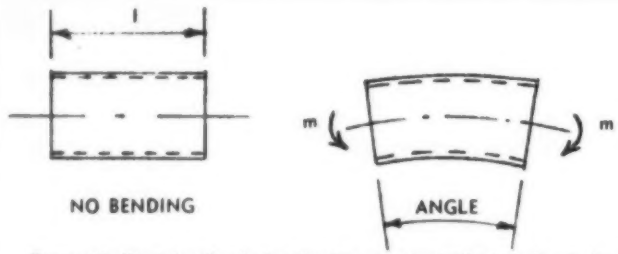


Figure 4A. Short length of pipe develops angular inclination due to bending moment.

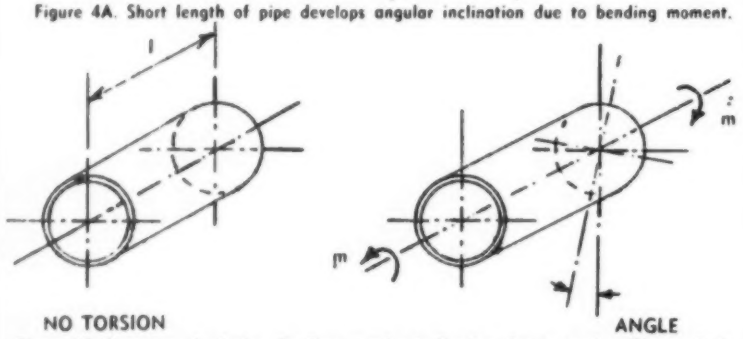


Figure 4B. Short length of pipe develops angular inclination due to torsion. The angle is actually about 30 percent greater than in (A) above, but this extra is neglected on the first form.

one enters the excess length of these pieces in Column 1 as 30 percent of their actual lengths in the x direction, or 31 inches. Piece 9 is handled similarly to Piece 5. The next piece more flexible for flexure in the "X Plane" is Piece 13. Since the k value for this bend is 2.39, this value is recorded in Column 2. The excess length of this bend is 1.39 times its actual length, so the length entered in Column 1 is 110 inches. In the row marked with an arrow, the "sum" values from the basic computations are entered. The total effective length for the "X Plane" is found to be 833 inches, by adding the figures in Column 1 of the "X Plane" block. The remainder of the computations for Columns 5 through 13 are made, except where blacked out as unnecessary, for this "X Plane" block.

The "Q" values are all unity, since the pipe is all one size and schedule. To illustrate the use of the Q factor, however, we suppose that Piece 5 has only half the wall thickness of the rest of the pipe. In that case its "I" value would only be about 80.4; one would compute Q = 160.8/80.4 = 2, and use 2 as the Q factor for Piece 5. The value in Column 1 row 5 would be entered as 158 instead of 79. The value for Column 1 in the "X Plane" block, for member 5, would be entered as 30 instead of 15. Since Piece 5 is a bend, its k value would be greater than 2.39 because of the thinner wall, and although this does not affect the "X Plane" block, that greater k value would be used (cumulative with the Q factor) for member 5 in the "Z Plane" block. The basic part of Column 1 has already had the Q factor applied to the lengths. In filling in the "X, Y and Z Plane" blocks, therefore, do not use the Q factor twice, by applying it to the lengths entered in the basic part of Column 1. Always apply the k and Q factors to the actual piece or member lengths.

A similar procedure is used for the "Y Plane" and "Z Plane" blocks. Then the circle-coded operations on the form are carried out, which should offer no special difficulty.

In making the moment and stress computations for various points on the piping, "β" factors are used in a fashion that needs explanation. For point A, the origin, the moments are those computed preceding as M_x, M_y and M_z. One needs to consider the actual directional orientation of the pipe at this point to correctly apply the "β" factors. So far as x and z moments are concerned, at point A, we have straight pipe in plane-bending. Consequently the β factor for these moments is taken as unity. For the y moment, however, the pipe is in torsion. The β factor for torsion may be taken as .71, for convenience, and this value is used to multiply the y moment, to find the effective moment insofar as the stress calculations are concerned. Column 11 is the sum of the squares of the effective moments. Taking the square root of this finds a resultant effective moment. Dividing this by the section modulus of the pipe (at the point involved) finds the effective expansion stress. The above is done in the Column marked "expans. stress."

For Point D, the factor for the x moment is taken as unity since the pipe is in plane-bending for x moments. The factor for the y moment is taken as 2.52 since this is the intensification factor for the elbow bending in its own plane, and it lies in the "Y Plane." The factor for the z moment is taken as .71 since z moments for this point produce torsion. The experienced analyst will note that the stress calculations used here imply "spherical interaction." Later in the form, where the combined stress due to the effect of pressure is computed, liberties are taken with the "precise" formulas for combined stresses, to achieve simpler results slightly on the safe side, for finding what amounts to the maximum principal stress for compari-

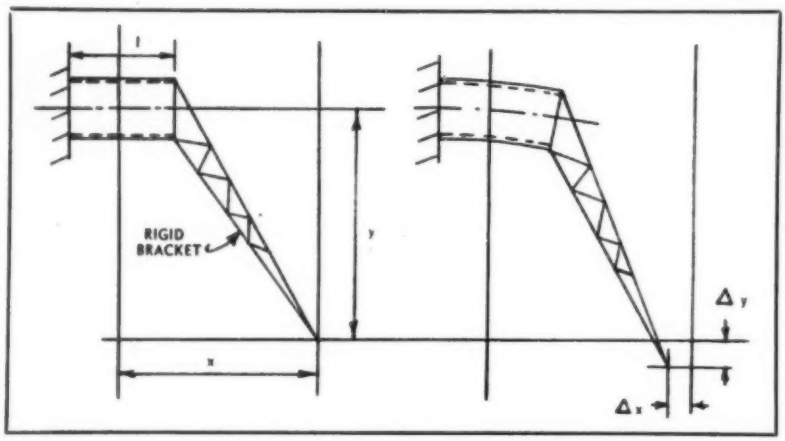


Figure 5. Movements at end of rigid bracket due to flexure in short length of pipe.

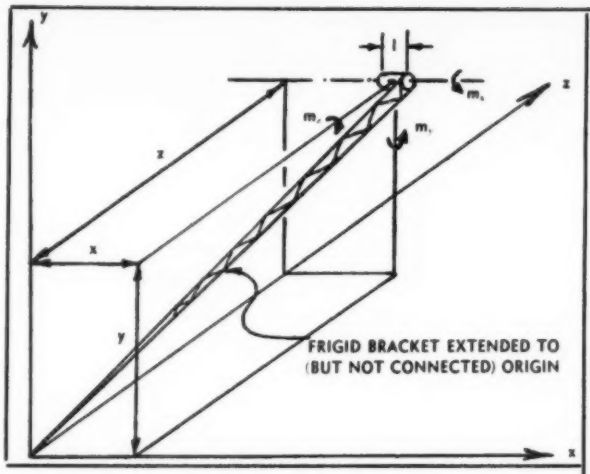


Figure 6 (above). Moments acting on short length of pipe in space.

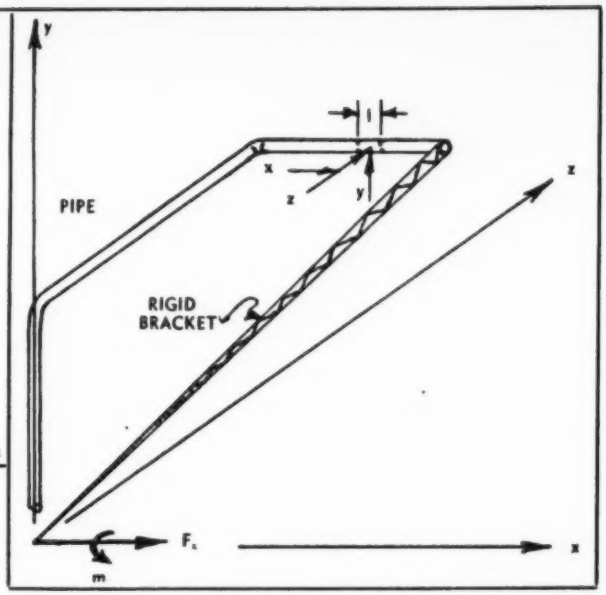


Figure 7 (right). Application of moments to short piece of pipe (through a rigid bracket, acted on by forces and moments located at the origin).

son with the allowable combined stress. In the central portion of the form, the points B, C and E are fictitious ones, at the corners of the layout, and are used to find a stress value at these points to see if those particular elbows could be points of maximum stress. Since Point C indicated a large stress, actual Point D was checked to find the actual stress at that point. The final section of this article presents an abbreviated mathematical outline of the method.

Appendix

Pipe is more flexible in torsion than in plane-bending, about 30 percent more so. By neglecting this extra flexibility, any piece of pipe can be regarded as equally flexible in any direction—a sort of "flexural isotropy," so to speak. When a short piece of pipe bends, essentially what happens is that the ends become angularly inclined, as shown in Figure 4. From basic structural theory we know that this angle, measured in radians, is equal to:

$$\phi = ml/EI$$

where m is the moment in inch-pounds; l is the length in inches; E is the modulus of elasticity of the material in psi, and I is the moment of inertia of the pipe cross-section in units of inches to the fourth power.

If one end of the pipe is fixed and the other end has a "rigid bracket" attached to it, any angular inclination in the piece of pipe shows up as an equal angular inclination in the bracket, and as motion of the end of the bracket. This is shown in Figure 5.

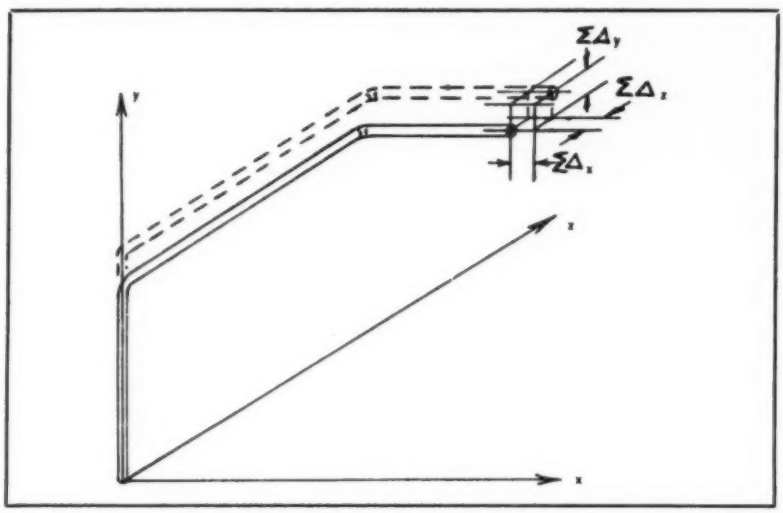


Figure 8. Motion of freed end of pipe due to expansion.

The amounts of movement are:

$$\Delta_z = y\phi = y(ml/EI) \text{ and } \Delta_y = x\phi = x(ml/EI)$$

The Δ_y is actually a little more, because the deflection of the piece of pipe itself helps this, but the extra can be neglected if the piece is rather short, compared to the length of the bracket in the x direction.

By setting up a coordinate system in space, a short piece of pipe with coordinates x, y and z may be considered to have a bracket connected to it which extends back to the origin of the coordinate system (but the bracket is not fastened to the origin). See Figure 6. Let us suppose the piece of pipe then has moments m_x, m_y, and m_z somehow applied to it. We can find the angular inclinations of the bracket. These are equal to the angular inclinations of the piece of pipe:

$$\phi_x = m_x l/EI, \phi_y = m_y l/EI \text{ and } \phi_z = m_z l/EI$$

We can also find the motions at the origin-end of the bracket. These are:

$$\Delta_x = z\phi_y - y\phi_z, \ \Delta_y = x\phi_z - z\phi_x \text{ and } \Delta_z = y\phi_x - x\phi_y$$

We can write the Δ_x equation differently by using the fact that

$$\phi_y = m_y l/EI \text{ and } \phi_z = m_z l/EI.$$

This gives us, by substitution:

$$\Delta_x = z(m_y l/EI) - y(m_z l/EI)$$

Similar equations are obtained for Δ_y and Δ_z.

Now consider Figure 7. Here is sketched a multi-plane run of pipe "free" at one end and fixed at the origin. A fictitious rigid bracket extends from the free end to the origin (but not connected to the origin). Force and moment in the x direction are shown acting on the origin end of the

bracket. Similar forces and moments are in the y and z directions, but for clarity are not shown. Now we can find what the moments (three: in the x, y and z directions) are at any point on the pipe, due to the forces and moments that have been applied at the end of the bracket, by using the principles of translation of forces and moments. This gives us:

$m_x = M_x + F_y x - F_z z$, $m_y = M_y + F_z z - F_x x$ and $m_z = M_z + F_y x - F_x y$

Going back to the Δ_x equation, we can substitute these above expressions for the m values in the Δ_x equation. This gives us:

$$\Delta_x = z(M_y + F_x z - F_z x)l/EI - y(M_z + F_x x - F_y y)l/EI$$

which reduces to:

$$\Delta_x = (F_x(z^2 - y^2)l - F_y xyl - F_z xzl + M_y zl - M_z yl)/EI$$

Similar expressions can be found for Δ_y and Δ_z.

This Δ_x that we have an equation for, is the motion of the origin-end of the bracket due to flexure in the short piece of pipe of length l, whose center is at the point whose coordinates are x, y and z, caused by the applied forces and moments at the end of the bracket. By dividing up the pipe into a number of short pieces, and adding up the contribution of each piece to the total Δ_x value, we can find the total movement of the end of the bracket in the x direction. We may also find the total angular inclination by adding up the angular inclinations of each piece of pipe. By substituting the expressions for the m values, we could find that each individual angular inclination was:

$$\phi_x = (-F_y zl + F_z yl + M_x l)/EI$$

with similar expressions for ϕ_y and ϕ_z.

Now consider Figure 8. There is sketched a run of pipe, which is to be heated and consequently will expand. If it is assumed disconnected from the upper right nozzle or anchor, and then permitted to expand, we find it in the dashed position. To bring the upper right end of the pipe back into contact with the upper right nozzle or anchor, will require forces and moments to cause flexure in the pipe. To compute these forces and moments (which exist as internal stress in the piping system, necessary to have brought the pipe back into contact with the nozzle) is the principal problem in piping flexibility analysis. We compute these forces and moments by setting the known (total) expansion movements of the end of the pipe equal to the equations for total movements that we have just derived. Note that there is no final angular inclination at the end of the pipe. Consequently the motion of the origin-end of a "fictitious bracket," is identical to the motion of the upper right end of the pipe to which it is assumed connected. It is immaterial whether the forces and moments are regarded to have come into the piping system via the upper nozzle or anchor, or through our fictitious bracket. Using Σ to identify sum total, we get:

$$0 = \Sigma(-F_y zl + F_z yl + M_x l)/EI - (\Sigma\phi_x)$$
$$0 = \text{Similar } (-\Sigma\phi_y)$$
$$0 = \text{Similar } (-\Sigma\phi_z)$$
$$\Sigma\Delta_x = \Sigma(F_x(z^2 - y^2)l - F_y xyl - F_z xzl + M_y zl - M_z yl)/EI$$
$$\Sigma\Delta_y = \text{Similar}$$
$$\Sigma\Delta_z = \text{Similar}$$

The "fictitious rigid bracket" is actually not so fictitious. Really, it is the rather complicated actual "bracket" that consists, starting from a particular piece of pipe, of the rest of the pipe to the upper right nozzle, the equipment to which this nozzle is attached, the structure and foundation to which this equipment is fastened, the soil around, and then the foundation, structure, equipment and nozzle at the lower left end, winding back to the flange contact face which was taken as the origin end of the pipe and coordinate system. In making the calculations for our pipe expansion flexibility, we are really trying to find out what are the internal shears and moments that exist in this "closed loop."

The Σ equations just written down, happen to be, as they stand, in a rather unhelpful form. This is because they tell us what the (known) movements are, in terms of the unknown forces and moments that we are actually trying to find. What we really need is a set of equations that would tell us what the unknown forces and moments are, in terms of the known expansion movements. If the equations were to be of greater help, they would far better look something like the set of equations written below:

$$F_x = a_1\Sigma\Delta_x + b_1\Sigma\Delta_y + c_1\Sigma\Delta_z + d_1\Sigma\phi_x + e_1\Sigma\phi_y + f_1\Sigma\phi_z$$
$$F_y = a_2\Sigma\Delta_x + b_2\Sigma\Delta_y + c_2\Sigma\Delta_z + d_2\Sigma\phi_x + \text{etc.}$$
$$F_z = a_3\Sigma\Delta_x + b_3\Sigma\Delta_y + c_3\Sigma\Delta_z + \text{etc.}$$
$$M_x = a_4\Sigma\Delta_x + b_4\Sigma\Delta_y + \text{etc.}$$
$$M_y = a_5\Sigma\Delta_x + b_5\Sigma\Delta_y + \text{etc.}$$
$$M_z = a_6\Sigma\Delta_x + \text{etc.}$$

In the above equations, the a's, b's, c's, etc., are all numerical coefficients. Our unknown forces and moments are on the left hand side of the equations, to be computed out by working out the values of the right hand side of the equations. The problem is, to find out what the numerical values of the a's, b's, c's, etc., are, so that we can work out these equations and find the unknown forces and moments. Going back and examining our set of Σ equations before the last set just written, we note that the right hand sides of these equations consist of forces and moments, and rather complicated numerical factors or coefficients. A sample one of these coefficients is $-\Sigma zl/EI$, and another one is $\Sigma(z^2 - y^2)l/EI$. Rather, the numerical values of these terms are the coefficients. These are sometimes referred to as "shape coefficients." We can, by using the principles of simultaneous equations, work out the values of our a, b, c, etc., coefficients, in terms of these latter "shape coefficients," once we have worked out the values of the shape coefficients themselves. Fortunately, we do not need to work out the values of the d, e and f coefficients, since they are used only to multiply "zero" values anyway (that is, the total angular inclinations). When we have the forces and moments, we note that they occur at the end of our "fictitious bracket." However, by utilizing the principles for translation of forces and moments, we can find the moments at miscellaneous points in our piping system. The forces are the same all over the piping, but the moments are different. The maximum moments (which usually produce the maximum stresses) usually occur at the ends or corners of the piping. We find the maximum stress by checking several points, combine this with our pressure stress, and compare this maximum combined stress with the allowable combined stress.

What is done in the first form of this article, is to organize a procedure which carries out all the steps described above, reduced to simple arithmetic. Sometimes we wish to take advantage of the 30 percent extra flexibility due to torsion. Also, elbows and curved pipe are more flexible than straight pipe, when flexed in their own plane. These "extra flexibilities" alter the values of the a's, b's, etc., mentioned above. The second form is essentially the same as the first form, but contains the extra calculations necessary to account for these extra flexibilities.

REFERENCES

1 "Design of Piping Systems," M. W. Kellogg Co., 1941.

2 "Piping Stress Calculations Simplified," S. W. Spielvogel, 1943.

3 "Piping Design and Engineering," Grinnell Co., 1951.

4 "Design of Piping With Flex-Anal Charts," Blaw-Knox Co., 1947.

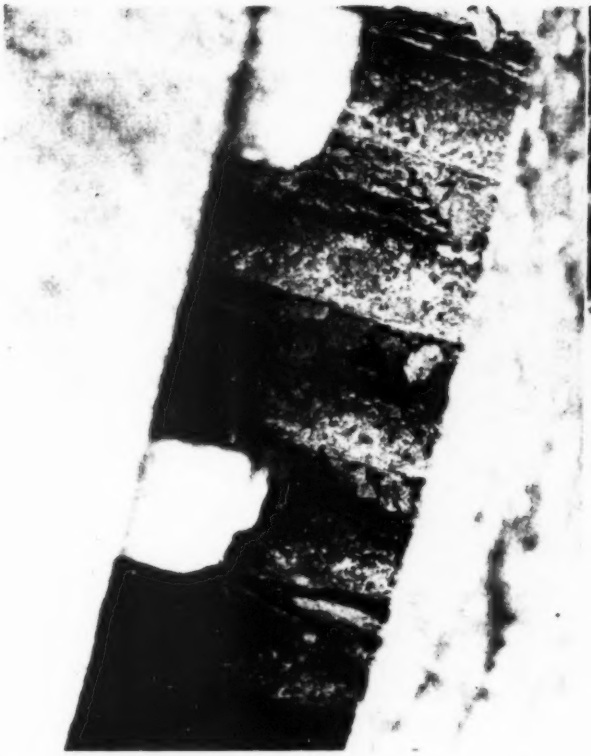
5 "Piping Engineering," Tube Turns Co., 1951.

6 "Navco Piping Datalog," National Valve and Manufacturing Co., 1950.

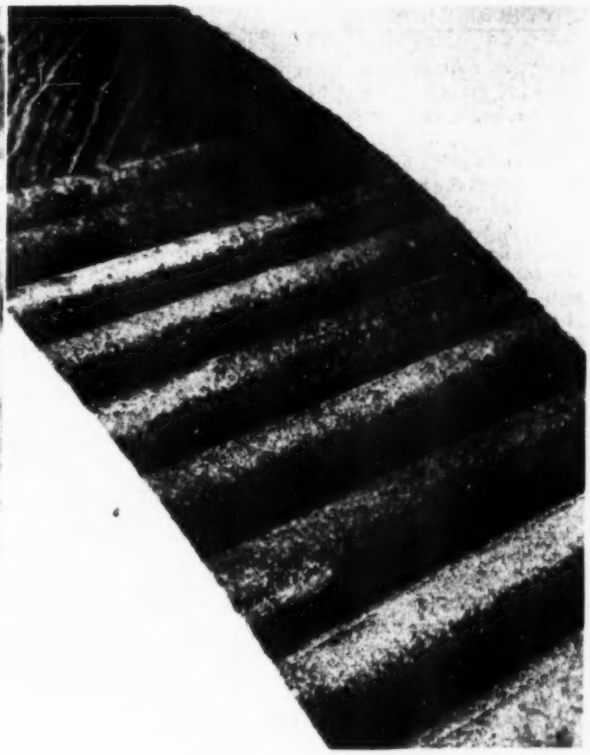
7 "Stress Ratios," F. R. Shanley and E. I. Ryder, Aviation Magazine, June, 1937.

ACKNOWLEDGMENT

The author thanks Brown & Root, Inc., for this opportunity to outline some of the analysis techniques employed in their work.



BEFORE—Interior of heat exchanger bundle showing accumulated iron oxide deposits.



AFTER—Same heat exchanger bundle following chemical cleaning treatment.

How . . .

Chemical Cleaning Makes Money

This is an actual case history of the profitable application of chemical cleaning to the restoration and cleaning of an entire section of a refinery. Demonstrated advantages are

◗ Inexpensive ◗ Efficient ◗ Speedy ◗ Safe

J. T. Browning,
Dowell Incorporated,
Chicago

AT THE END of World War II there was an immediate reduction in the production of toluene. Much of the equipment that has been used for the manufacture of this vital war commodity was taken from service. In many cases there was no immediate use for such specialized processing equipment. Between 1945 and 1951, at Standard Oil Company (Indiana's) Whiting refinery, the demand for pure petrochemical products was not great enough to warrant conversion to another use. However, with the Korean war came an urgent demand for benzene, and aviation gasoline components. To meet this demand action was taken to reactivate the toluene unit for the production of high quality benzene and stock for aviation gasoline.

The long lay-up period caused serious oxidation to occur in bubble towers, lines and exchangers included in this unit. Inspections revealed heavy layers of sloughed and tightly adhering iron oxide throughout the system. A thorough cleaning job of this unit was imperative.

Before calling in a chemical deposit removal service company, refinery personnel exerted considerable effort toward the rehabilitation of this unit by mechanical means. Inspections indicated that severe oxidation of bolts and nuts made it impossible to remove them without air chisels. Trays, bubble caps and other tower appurtenances were so badly corroded it was next to impossible to remove them without causing considerable damage to tower internals. The interiors of exchangers were found to be quite heavily loaded with sloughed iron oxide deposits. A composite sample of the deposit from

MAINTENANCE / OPERATION

the entire unit indicated that it consisted principally of Fe_2O_3 iron oxide, with approximately 15 percent organic material.

The unit itself consisted of three bubble towers of the following dimensions: 7½ feet in diameter by 85½ feet high; 8 feet diameter by 115 feet high; and 7½ feet diameter by 103 feet high. Contained in the unit were 17 exchangers ranging in size from 2½ feet diameter by 17 feet long to 6⅔ feet diameter by 17 feet long. There were also miscellaneous lines in the unit, ranging from ¼-inch instrument lines to 8-inch pump suction lines. The volumetric capacity of this system was calculated to be approximately 125,000 gallons.

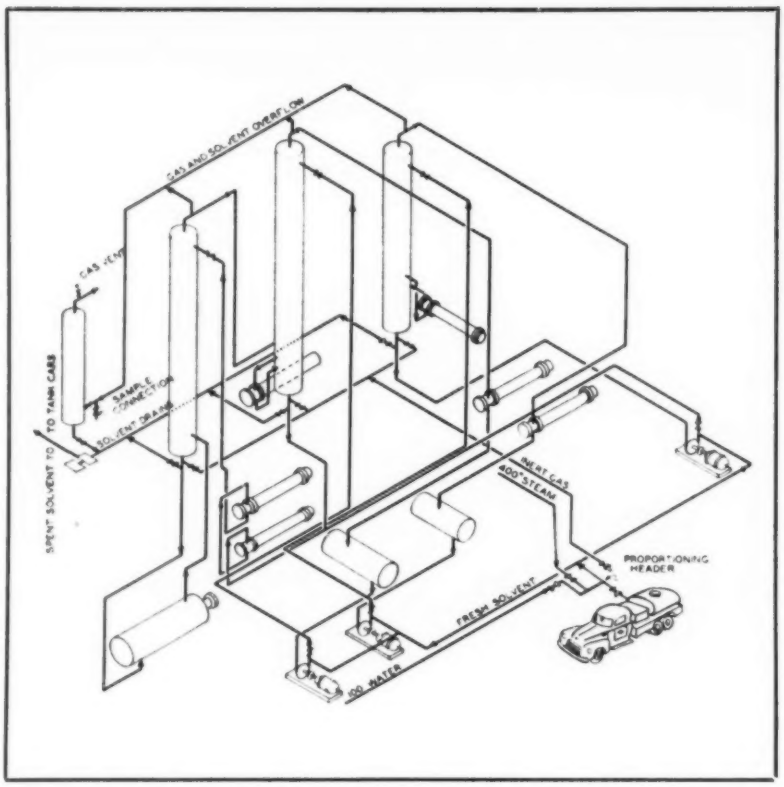
Due to the size of the unit it was considered feasible to conduct an experimental treatment on a small portion of the system to establish the treating technique for the larger job. An exchanger and connecting piping were selected for the trial treatment. Solvent was compounded on the basis of laboratory tests on the deposit samples taken from the unit. Proposed treating conditions were also recommended from the laboratory results.

The technique used in the experimental treatment proved extremely effective. Intermittent circulation through the exchanger and piping, assisted by inert gas agitation, did a thorough job in removing the deposit from the shell side of the exchanger. A weak phosphoric acid solution was used to passivate the newly cleaned internal surfaces at the conclusion of the trial treatment.

Upon inspection, the exchanger was found to be completely free of deposit. Based on a thorough examination of this experimental job, refinery personnel decided to use the trial procedure in cleaning the complete unit.

Inasmuch as towers contained cast iron trays and bubble caps, it was necessary to introduce the solvent into the towers at approximately 125 to 130 F. Before starting the treatment the equipment was preheated to approximately 140 F. by introducing steam into the lines and towers. To compensate for low treating temperatures for iron oxide, a 24 contact period was used.

An interesting phase of this treatment was the use of CO_2 gas for agitation. Liquid CO_2 was delivered to the job site by the Cardox Corporation in a 10-ton-capacity trailer. This firm furnished a vaporizer through which the CO_2 liquid was passed. Steam was introduced in order to vaporize the CO_2 liquid.



Piping arrangement for chemically cleaning towers—toluene extraction unit—light oils department.

CO_2 gas at a rate of 100 to 140 cubic feet per minute was introduced into the connections on the bottom end of each tower. The introduction of gas was begun when solvent was started through the reflux line, which entered the towers just over the top tray of each tower. The first solvent was allowed to pass through the tower and out to waste. As soon as drain sample analyses showed that the solvent in the tower had attained the proper concentration, the tower drain was closed and the solvent allowed to accumulate until the towers were filled. Lines that did not fill during this solvent introduction period were contacted by bleeding off during the soaking period. Intermittent agitation was used throughout the filling, soaking and subsequent water flushing periods. Approximately 15 tons of liquid CO_2 were used on the job.

After the towers had been thoroughly flushed, by the introduction of water at the top, the system was completely drained in preparation for the introduction of phosphoric acid. Six hundred gallons of 75 percent phosphoric acid was diluted to make 2000 gallons of 22 percent acid, which was halued to the job. Inhibitor was added to the phosphoric acid to protect the metal equipment.

The phosphoric acid stage was conducted by first filling one of the towers with water and circulating with one of the pumps. Twenty-two percent phosphoric acid was then added to the discharge from the pump in proper proportion to make a 1 percent solution. Additional water was added and circulation continued until the complete system was filled with a ¼ to ½ percent solution. Heat was applied to the reboilers on these towers to bring the temperature of solution up to approximately 200 F. A contact period of approximately six hours was used.

Inspection of the unit following this treatment showed it to be free of iron oxide deposits, adhering to the metal. Little hosing was necessary in order to put the tower in condition for refinery operations.

Chemical cleaning has many other applications in the refinery. The chemical removal of deposits from many types of equipment has made possible the reduction of maintenance costs, reduction of equipment outage periods and reduction of hazards to maintenance personnel.

MAINTENANCE / OPERATION

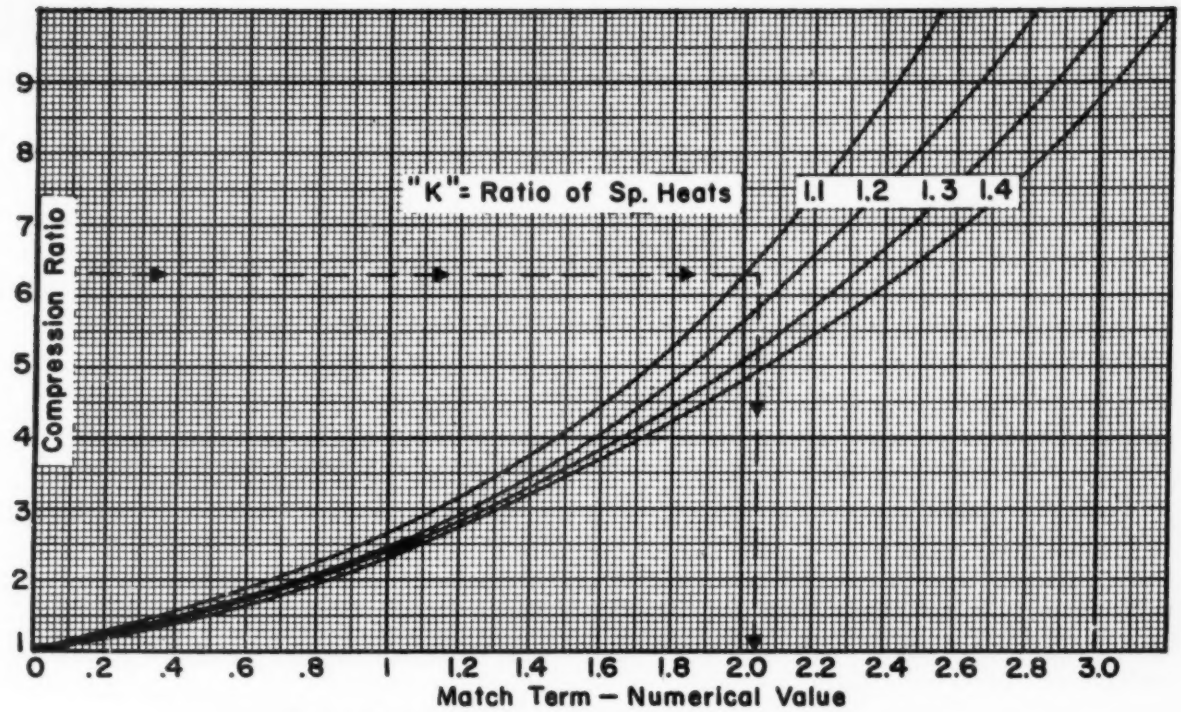


Figure 1. Effect of compression ratio and specific heats on the Match Term.

In two minutes you can analyze graphically . . .

Centrifugal Compressor Performance

- New Pressures
- New Temperatures
- New Speeds
- New Horsepower

S. R. Steinbock,
Barrancabermeja, Colombia

THE PERFORMANCE of centrifugal compressors is so vital to plant operation that a comprehensive understanding of their operating characteristics becomes absolutely essential. In general, operating characteristics must be analyzed for two reasons:

(1) Operating conditions are different from the original design basis and it becomes necessary to modify certain variables to attain desired results.

(2) When specifying a new compressor sufficient flexibility is desired to cover a wide range of operating conditions.

This article contains a simplified graphical method of analyzing the performance characteristics. The usual tedious mathematical analysis is eliminated.

This method is a solution of two simultaneous equations correlating adiabatic head with machine and gas variables. The first equation states that the adiabatic head varies directly as the square of the speed of the machine. The second is the expression for the adiabatic head:

$$H = \left(\frac{1545}{M}\right)\left(T\right)\left(\frac{k}{k-1}\right)N\left[r^{\left(\frac{k-1}{k}\right)}-1\right] \quad (1)$$

Where H = Adiabatic head in ft lbs./lb.
M = Molecular weight of gas in lbs./mole.
T = Inlet temperature to the compressor, °R.
k = Ratio of specific heats.
r = Compression ratio.

The last term in Equation (1) is often designated by "X," so that the equation may be written as:

$$H = \left(\frac{1545}{M}\right)\left(T\right)\left(\frac{k}{k-1}\right)\left(X\right)$$

MAINTENANCE / OPERATION

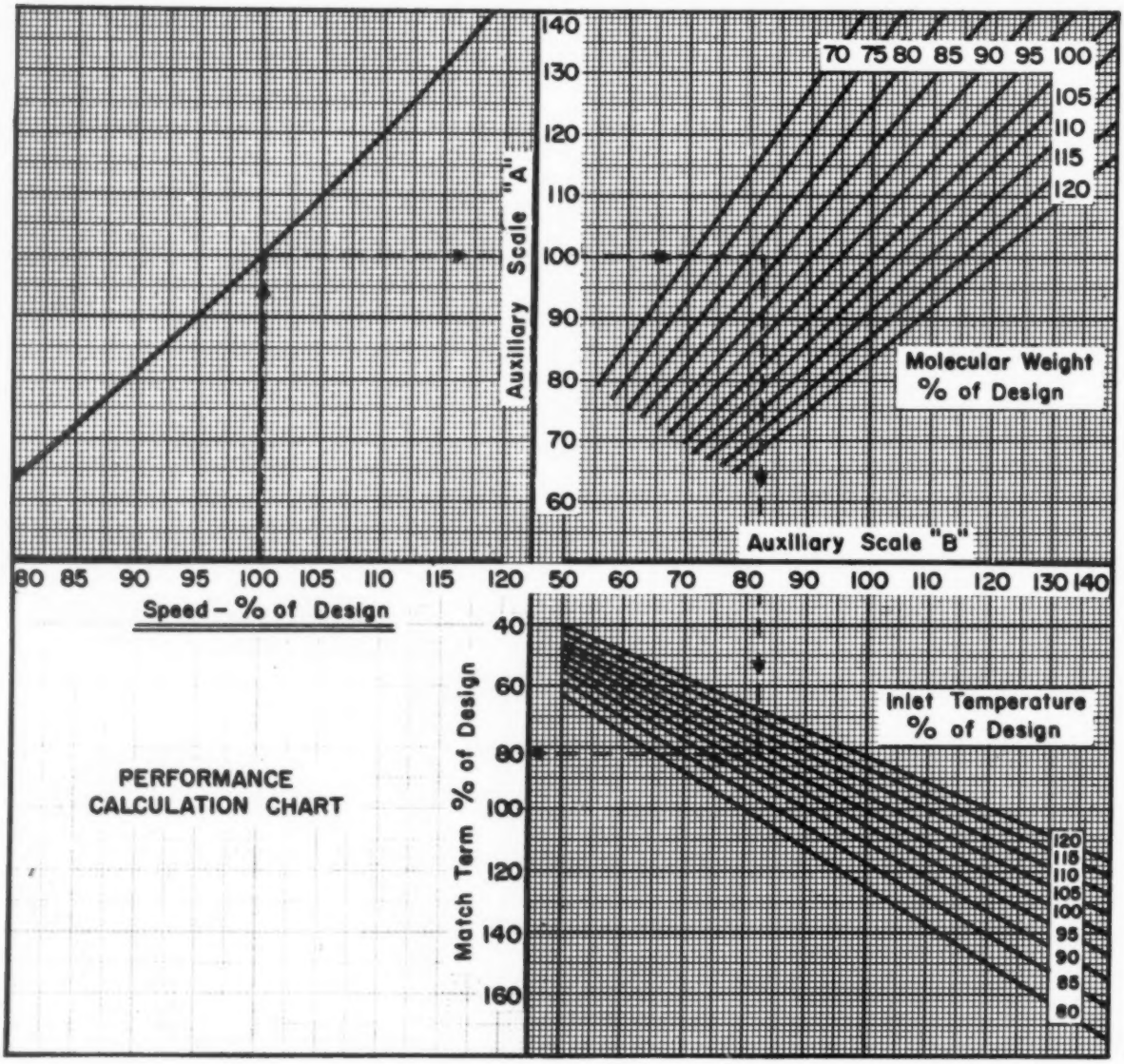


Figure 2. Performance calculation chart.

and in the graph the term

$$\left(\frac{k}{k-1}\right)\left(X\right)$$

is referred to as the "match term."

In most applications the aim is to maintain a certain pressure ratio. This method will prove very useful in estimating adjustments which should be made.

The following examples will illustrate the simplicity of the performance calculation.

MAINTENANCE / OPERATION

Example 1

A gas compressor installed in a certain oil refinery was designed on the following basis:

Speed	7600 rpm.
Disch. pressure	105 psia.
Suction pressure	16.5 psia
Inlet temperature	90 F.
Mol. weight	44
k	1.12

Under actual conditions, however, the molecular weight of the gas is only 36 and the suction pressure cannot be raised. Therefore the desired discharge pressure cannot be attained without making certain adjustments. Find:

(a) The discharge pressure available from the compressor under these conditions.

(b) To maintain the design discharge pressure, what adjustment should be made in the speed of the machine or in the inlet temperature of the gas?

Solution:

$$\text{Design pressure ratio} = \frac{105}{16.5} = 6.35$$

Actual mol. wt. percent ratio =

$$\left(\frac{36}{44}\right)\quad\left(100\right) = 82 \text{ percent of design.}$$

From Figure 1 read off design "match term" = 2.04

Step a

On Figure 2 proceed vertically up from 100 percent on the speed scale to the intersection of the curve and then to the right until the 82 percent mol. wt. line is met (interpolate between 80 and 85 percent). Thence proceed vertically down to the 100 percent temperature line and then to the left and read off "match term" 82 percent. Thence "match term" under these conditions becomes

$$\left(\frac{82}{100}\right)\left(2.04\right) = 1.67$$

Referring again to Figure 2, find that at a "match term" of 1.67 the compression ratio is 4.60. Thence the discharge pressure will be

$$(4.60)\ (16.5) = 76.0 \text{ psia}$$

Step b

(1) New speed required:

If it is desired to maintain the discharge pressure, the match term would be maintained at 100 percent. (This only applies if there is no appreciable change in "k." Otherwise a new match term must be determined taking into account the different "k" value.)

Starting from the "match term" scale = 100 percent on Figure 2, draw a line to intersect the 100 percent temperature line and then a vertical line to meet the 82 percent mol. wt. line. From here proceed to the left to the intersection of the speed curve and find the new speed to be 111 percent of design, i.e. $\left(\frac{111}{100}\right)(7600) = 8436$ rpm.

(2) New temperature required:

If an adjustment in the inlet temperature is desired, start from the speed scale (100 percent) and proceed to the speed curve. Then draw a line to the 82 percent mol. wt. line and proceed vertically down. Now starting from the Match Term scale (100 percent) proceed horizontally until the previous line is intersected. Thus a point is found corresponding to 82 percent of design temperature. Hence inlet temperature should be $\left(\frac{82}{100}\right)(460 + 90) = 450$ F. absolute, or 10 F.

In actual practice it may not be practical to reduce the temperature this low, and it may well be that the speed could not be safely increased by 11 percent. A compromise is therefore possible, whereby both the speed of the machine and the inlet temperature are changed. Various combinations of such changes can be readily computed and tabulated from the attached graph.

Example II

It is desired to specify conditions for a centrifugal compressor which is known to have to operate over a wide range of conditions.

Suction pressure	= 16.5 to 25 psia
Discharge pressure	= 105 psia
Mol. wt.	= 37 to 45
k value	= 1.15 to 1.12
Inlet temperature	= 90 F.

What are the conditions which should be specified to assure that the machine will operate satisfactorily over the full range?

Pressure ratio = 6.35 to 4.2
(Specify the higher ratio as 100 percent of design)

Mol. wt. = 37 to 45
(Specify the lower mol. wt. as 100 percent of design, i.e. mol. wt. = 45 becomes 121 percent of design.)

From Figure 1:

Compression Ratio	k	Match Term
Design Basis:		
6.35	1.12	2.04
6.35	1.15	2.07
80 Percent of Design Basis (approx.):		
4.2	1.12	1.64
4.2	1.15	1.66

Now from Figure 2 can be easily seen that:

(a) With a match term of 80 percent of design and mol. wt. of 100 percent of design, the speed will have to be reduced to 88.5 percent of design.

(b) With a match term of 80 percent of design and mol. wt. of 121 percent of design, the speed will have to be reduced to 81 percent of design.

(c) If the machine operates on the high compression ratio, the match factor is 100 percent and if the mol. wt. of the gas is 121 percent of design, the speed will have to be reduced to 92 percent.

How To Determine the Driver Horsepower:

It is also necessary to check in all cases that the available driver horsepower is adequate for the contemplated operating conditions. The shaft horsepower at the compressor coupling is:

$$HP = \left(\frac{P_1 V_1}{229}\right)\left(\frac{k}{k-1}\right)\left[\left(\frac{P_2}{P_1}\right)^{\frac{k-1}{k}} - 1\right]\left(\frac{1}{e}\right) \qquad (2)$$

Which can also be written as:

$$HP = \frac{P_1 V_1}{229e} \text{ (match term)} \qquad (3)$$

and P_1 = Compressor inlet pressure in psia

P_2 = Compressor discharge pressure in psia

V_1 = Gas inlet volume in cfm at inlet conditions.

e = Polytropic and mechanical efficiency of the compressor.

The "match term" can be readily found from the graph, and then it becomes merely a question of substitution in Equation (3) to find the horsepower under any set of given conditions.

A rough estimate of compressor efficiencies may be made for preliminary calculations, but they should be checked with the manufacturers. The important factor to remember is that the polytropic efficiency will not remain constant. It will vary with the volume of gas passing through the machine, and is of particular importance in the case of multistage compressors operating over a wide range of compression ratios or volume.

MAINTENANCE / OPERATION

Interested in

MAINTENANCE?

☆

Petroleum REFINER'S entire Maintenance Special Section

as published in the January, 1954, issue is now available in REPRINT FORM.

32 profit-packed pages summarizing the wisdom and knowhow of carefully chosen experts.

☆

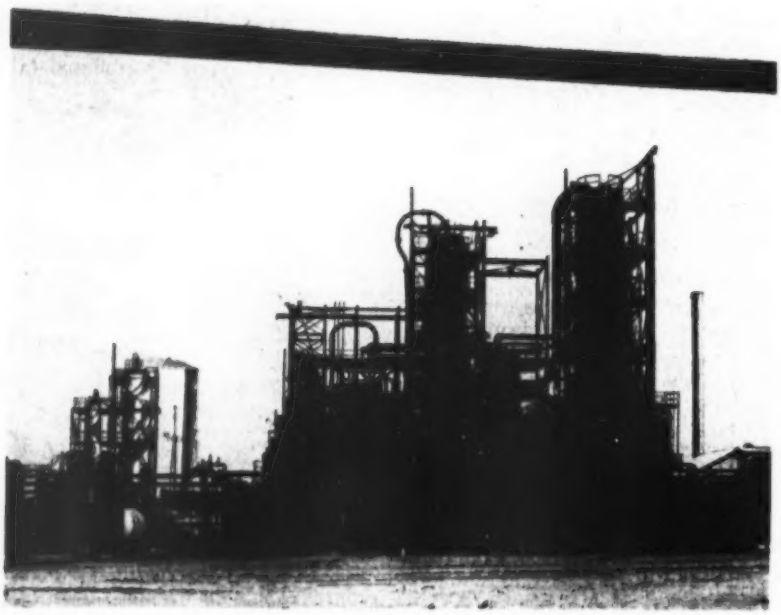
$1 per copy
(cash with order, please)

☆

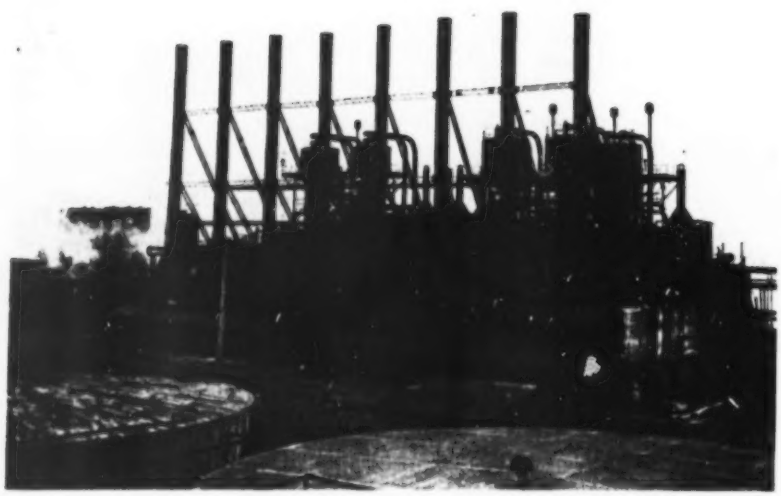
Reprint Dept.
Petroleum Refiner
Box 2608, Houston 1, Texas

Imperial planning . . .

To Revamp Maritime Refinery



IT STAYS—Only piece of equipment to survive revamping will be the cracking section of this combination unit.



THEY GO—These 1916 batch stills will make way for more modern equipment.

THE LARGEST refinery construction project ever undertaken in Canada and one of the largest single construction projects in the history of the Maritimes was announced last month by George R. McMillin, superintendent of Imperial Oil Limited's Maritime refinery at Imperoyal, near Halifax.

In a building program estimated to cost between $25 and $30 million, Imperial, affiliate of Standard Oil Company (New Jersey), will replace most of its existing plant with a brand-new refinery of almost double the capacity.

When construction is complete, the Maritimes will have a refinery that incorporates the latest developments in petroleum processing, including one of the largest Fluid catalytic cracking units in Canada.

Daily capacity of the new plant will be 41,625 barrels. This will make it one of Canada's major oil refineries, bigger than anything west of the Great Lakes and—in the Imperial family of nine refineries—surpassed only by the plants at Sarnia and Montreal. Present capacity at Imperoyal is 22,000 barrels a day.

McMillin, who became superintendent at Imperoyal at the first of the year, said that engineering design for the new plant is under way and would take some time. Construction should start early in 1955 with completion in the summer of 1956. The existing plant will continue in operation during the construction period.

The new refinery will be built on the present site at Imperoyal, across the harbor from Halifax and three miles south of Dartmouth. It will serve the Maritime provinces and Newfoundland, including Labarador, with products made from crude oil brought by tanker from Venezuela.

One of the features of the new refinery will be a Model IV Fluid catalytic cracking unit with a capacity of 27,000 barrels a day—among the largest cat crackers in Canada.

Other refining equipment to be installed at Imperoyal includes an atmospheric and vacuum distillation unit, a catalytic polymerization unit, a gas recovery plant, a treating plant and a naphtha specialty plant. Additional construction will include mechanical shops for the greatly-enlarged plant, a laboratory and technical building, loading racks from which products will be shipped and facilities for providing the refinery with water, steam and electricity.

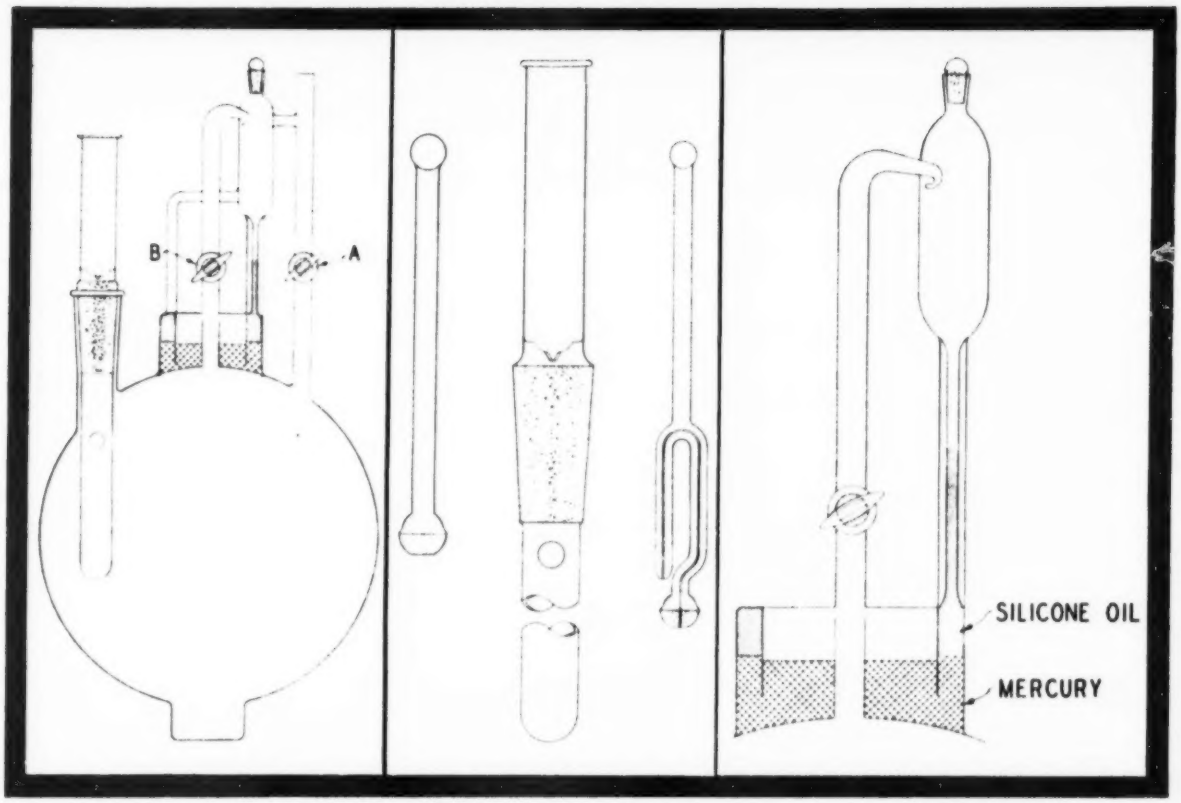


Figure 1. Vapor equivalent apparatus Figure 2. Sample measurement and entry system Figure 3. Multiplying manometer

Speed up . . .

Natural Gasoline Analysis

By this rapid method, liquid residues can be analyzed for:

♦ Vapor Equivalent ♦ Molecular weight ♦ Liquid/gas ratio

S. T. Preston, Podbielniak, Inc., Chicago
Dan E. Smith, Phillips Petroleum Company, Bartlesville, Okla.

IN THE LOW temperature analysis of natural gasolines, the light hydrocarbons through butanes or pentanes are removed in the vapor phase and the heavier fractions are removed as a liquid residue. In order to combine these measurements to obtain the composition on a mole percent basis (as is needed to compute vapor pressure) the molecular weight or vapor equivalent of the liquid residue must be determined. Formerly available methods were too time consuming to be used on a routine basis. Although correlations between gravity and vapor equivalent or molecular weight have been used extensively, the weakness of these correlations has been indicated previously.[1] The method described herein permits the rapid comparison of the molecular weight and/or vapor equivalent of an unknown to that of a known pure reference material.

Description of Apparatus

The apparatus is illustrated in Figure 1. It consists of (a) the sample measurement and entry system, (b) the multiplying manometer, and (c) the vaporization flask.

(a) Sample Measurement and Entry System—This apparatus is shown in Figure 2. It consists of a sample pycnometer and an orifice type sample entry system. The apparatus is a modification of that described by Consolidated Engineering Corporation.[2] The pycnometer is constructed from a 12/1 spherical joint of sufficient length to contain between 0.07 and 0.08 milliliters. The ends are constricted to minimize evaporation loss. A syringe equipped with a blunt needle point is used for filling the pycnometer.

The orifice in the entry system is located below the spherical joint as shown in Figure 2. The capillary end is sealed off and ground flat until a small orifice appears. The spherical joint is then sealed into a tapered joint which is extended to furnish a receptacle for the mercury which leaks through the orifice during sampling.

(b) Multiplying Manometer—This apparatus is designed to permit the complete vaporization of liquid residues (mixtures of hydrocarbons ranging from isopentane to n-decane with trace quantities of material heav-

ier than decane), consequently it is essential that the total pressure be maintained below the dew point pressure of the mixture. The vapor pressures of some of the hydrocarbons encountered are given in Table 1.

TABLE 1
Vapor Pressure at 100 F
(in mm. of Hg.)*

nC_7	83.6
nC_8	27.7
nC_9	9.24
nC_{10}	3.77

*From ASTM Special Technical Publication No. 109 (1950)

A limiting pressure of 1 mm. absolute was arbitrarily selected as the design basis for the apparatus.

Since the total pressure rise within the vaporization bulb is small a multiplying manometer capable of giving the desired accuracy in the pressure readings is required. Originally a manometer was developed which, although satisfactory, was somewhat fragile and incapable of being transported. In an effort to increase the ruggedness of the apparatus and make it portable, this manometer has been modified to the form shown in Figure 3. An increase in pressure within the vaporization bulb acts upon the mercury through opening "C." Displacement of the mercury causes the level of the second manometer fluid to be displaced in the small diameter leg (3 mm. id.).

The amplification of the manometer may be computed by determining the pressure rise which would cause a 1 mm. displacement of the mercury in the large diameter sections of the manometer. The surface area of the mercury on each side of the partition is 1000 square millimeters, therefore the volume of mercury displaced is 1000 cubic millimeters. The displacement of the interface of the second manometer fluid ($\triangle M$) is given by:

$$\frac{\pi(3)^2}{4} \triangle M = 1000 = \text{Volume displaced}$$

From which $\triangle M$ is found to be 141.47 mm. The pressure rise causing this travel is therefore:

$$\triangle P = 2 + \frac{141.47 \times d_1}{13.6}$$

d_1 = density of second fluid

Using a value of 1.00 (butyl phthalate) as the density of the second fluid:

$$\triangle P = 2 + 10.4 = 12.4 \text{ mm. of Hg.}$$

The amplification factor is therefore, 141.47/12.4 or 11.41

$$\triangle P = \frac{\triangle M}{11.41} = \triangle M \times k$$

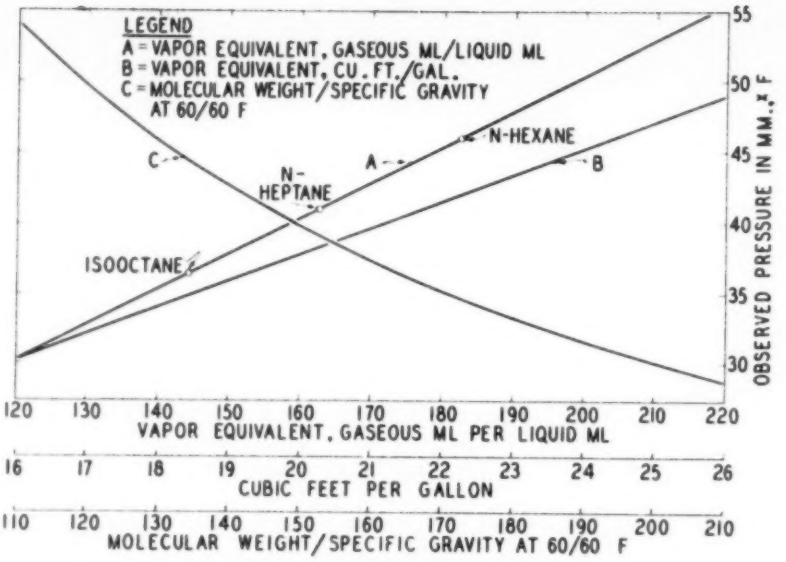


Figure 4. Calibration chart for vapor equivalent.

where $k = \frac{1}{11.41}$ = manometer constant

A small bulb is needed on the top of the manometer to prevent errors due to compression of the gas above the second manometer fluid. A volume of 30 ml. will effectively eliminate errors from this source, if the pressure in this section is reduced to 0.1 mm. of Hg. before tests are made.

(c) Vaporization Bulb—Having established the limiting operating pressure as 1 mm. of Hg., sample size is directly related to the size of the vaporization bulb, consequently the vaporization bulb must be made sufficiently large to permit accurate measurement of the liquid sample. A volume of three liters requires a sample of about 0.075 ml. which is sufficient for accurate measurement.

The vaporization bulb is mounted in a water bath with the water level sufficiently high to cover all parts of the vapor space.

Preparation of Apparatus

The apparatus is mounted in the water bath with metal clips as shown in Figure 5.

(a) Filling the Manometer—Both stopcocks are opened, the manometer cap is removed, and enough triple distilled mercury is added to half-fill the large diameter section of the manometer. The manometer is then filled with the silicone oil to about one inch above the base of the capillary. The appartus is tilted slightly so the air bubbles will escape through the capillary. The remaining air bubbles may be removed easily by applying a slight positive pressure through the pump stopcock while the other stopcock is closed. Care should be taken to prevent spilling mercury from the manometer into the flask.

(b) Degassing the Manometer Fluid—Silicone oil or butyl phthalate contains an appreciable quantity of dissolved air which must be removed by prolonged evacuation. The manometer cap is temporarily sealed in place with stopcock grease. The entry system is sealed with mercury and the ground joint plug. A vacuum is then applied through stopcock "A" with stopcock "B" open and the apparatus is evacuated. The vacuum is applied cautiously at first to prevent foam from entering the large flask. Excess oil may be removed at the completion of degassing by applying slight pressure through stopcock "A" and withdrawing the oil from the enlarged portion with a glass tube.

Calibration of Apparatus

The apparatus is calibrated with pure hydrocarbons having molecular weights between 72 and 150. Normal hexane, normal heptane, and iso-octane are readily available and will readily define the calibration curve.

(a) Procedure—The apparatus is evacuated, both stopcocks are closed, and the initial reading on the multiplying manometer is recorded. A portion of the pure hydrocarbon is drawn into the syringe. The pycnometer is then filled by touching the syringe needle to the center of the ball joint. The plug is removed from the entering system and the pycnometer is in-

serted. The plug is replaced after the sample is entered. The room temperature is recorded.

The final reading on the multiplying manometer is recorded after the pressure reaches equilibrium. The difference between the initial and final pressures is recorded as the pressure rise in millimeters. The procedure is repeated at least twice for each pure material used in the calibration.

(b) Calculations—Figure 4 was constructed to serve as a rapid method of calculation and requires only that the apparatus be calibrated and related to the chart with a calibration factor. It is based on a theoretical sample size and flask volume, and therefore, would not necessarily fit any existing apparatus. The calibration factor is determined as follows:

(1) Calculate the vapor equivalent of the calibrating materials using the formula below or that presented in the section on Derivation of Calculation Procedures.

$$V.E. = \frac{S}{MW} \times 23{,}690$$

where V. E. = Vapor equivalent, gaseous ml/liquid ml at 60 F.
S = Specific gravity at 60/60 F.
MW = Molecular weight

(2) Read the pressure opposite the theoretical vapor equivalent as given on Figure 4. Divide this value by the pressure obtained during the calibration with this same material. The result is the calibration factor. Each calibrating material should, theoretically, give the same factor.

A new factor must be determined for each pycnometer and for each bath temperature.

Operating Procedure

The sample is entered at approximately the same temperature* as in the calibration, and in the same manner. The pressure is then allowed to reach equilibrium and is recorded. This value is then multiplied by the calibration factor, F, and the vapor equivalent is read on Figure 4 in either gaseous ml/liquid ml or cubic feet/gallon. If the molecular weight is desired the specific gravity is determined and multiplied by the value on the Figure listed as molecular weight/specific gravity.

Derivation of Calculation Procedure

The calculation chart presented in the description of the operating procedure is based on the following:

Figure 5. Vapor apparatus equivalent apparatus.

(a) Vapor Equivalent (cubic feet per gallon)—If the volume of the vaporization bulb is designated as V (in liters), then the volume of vapor (at standard conditions) formed by the vaporization of any sample is:

$$V \times \frac{519.69}{T} \times \frac{\Delta P}{760} \times \frac{1}{28.316}$$

= cu. ft. of vapor at 60 F and 760 mm.

where V = volume of vaporization bulb (liters)
T = temperature of vapor (°R)
ΔP = pressure rise (mm. of Hg.)

A liquid sample (c, in ml.) added to the apparatus is corrected to the volume it would have occupied at 60 F. in gallons by:

$$c \times b \times \frac{1}{3785.33}$$

= Gallons of liquid at 60 F

where c = volume of liquid sample in ml. (measured at a temperature T)

$$b = \frac{\rho_T}{\rho_{60}}$$ (ratio of density of sample at T to density at 60 F)

Dividing the volume of vapor (in cubic feet) by the volume of liquid (in gallons) gives:

$$\frac{V \times \frac{520}{T} \times \frac{\Delta P}{760} \times \frac{1}{28.316}}{c \times b \times \frac{1}{3785.3}} = \frac{\text{cu. ft. at 60 F and 760 mm.}}{\text{Gal. at 60 F}}$$

Combining the constant terms of the above relationship:

$$\frac{V}{c} \frac{\Delta P}{b T} \times (91.412) \quad \frac{\text{cu. ft.}}{\text{gal.}}$$

As indicated previously, the reading on the multiplying manometer is related to the true pressure rise by a constant factor, or:

$$\Delta P = \Delta M \times k$$

where ΔM = reading on manometer
k = a constant depending on construction of manometer

Substituting this value of ΔP in the equation above and combining all constant terms $\left(\frac{V \times k}{c}\right)$ (91.412) the relationship simplifies to:

$$K\left(\frac{\Delta M}{b T}\right) \quad \frac{\text{cu. ft.}}{\text{gal.}}$$

where K = combination of all constant terms (calibration constant of apparatus)

(b) Vapor Equivalent (ml. gas/ml. liquid)—The vapor equivalent in metric units is related to the vapor equivalent in cubic feet per gallon by the ratio (28316./3785.33) or:

$$\frac{\text{cu. ft.}}{\text{gal}} \times 7.488 = \frac{\text{ml. gas}}{\text{ml. liquid}}$$

(c) Liquid to Gas Ratio—The liquid to gas ratio, frequently used in the calculation of results of low temperature fractional analysis, is the reciprocal of the vapor equivalent as expressed in metric units above.

(d) Molecular Weight—The determination of molecular weight is based on the following relationships:

$$PV = nRT$$

where P = pressure (mm. of Hg.)
V = volume (liters)
n = number of moles
R = gas constant (34.645)
T = vapor temperature

and $n = \frac{c \times b \times \rho_{60}}{MW}$

where ρ_{60} = density of liquid sample at 60 F.
MW = molecular weight of sample

combining the above equations and regrouping the terms gives:

$$\frac{MW}{\rho 60} = \frac{c}{V \times k} \frac{b T}{\Delta M} R$$

Combining this relationship with that of vapor equivalent (in cu. ft./gal.) gives:

$$\frac{MW}{\rho_{60}} \quad \frac{(91.412)\ R}{V.E.} = \frac{3166.96}{V.E.}$$

REFERENCES

[1] Preston, S. T., "A Total Vaporization Method," Pet. Engr., Vol. 24, No. 10, p. C-34-36, (1952).

[2] Bulletin 1817, "Sample Introduction Equipment," Consolidated Engineering Corp., Pasadena, Calif.

* The result will be in error by about 0.5 percent for each 10 F variation from the calibration temperature.

Temperature measurements quick and easy with this . . .

Portable Thermowell

R. G. Sanders, Magnolia Petroleum Company,
Beaumont, Texas

A PORTABLE thermowell which permits quick and easy measurements of temperature at any point where drain or bleeder valves are located is shown in Figure 1. This thermowell has been tested successfully in lines having pressures up to 200 psig, and might be used at even higher pressure.

The size of the thermowell is governed by the size of these connections. The thermowell consists of a threaded tube which carries an iron-constantan thermocouple in the tip and a conventional thermowell head on the outer end where potentiometer leads are connected. The threaded tube is run through a packing gland to seal it against pressure.

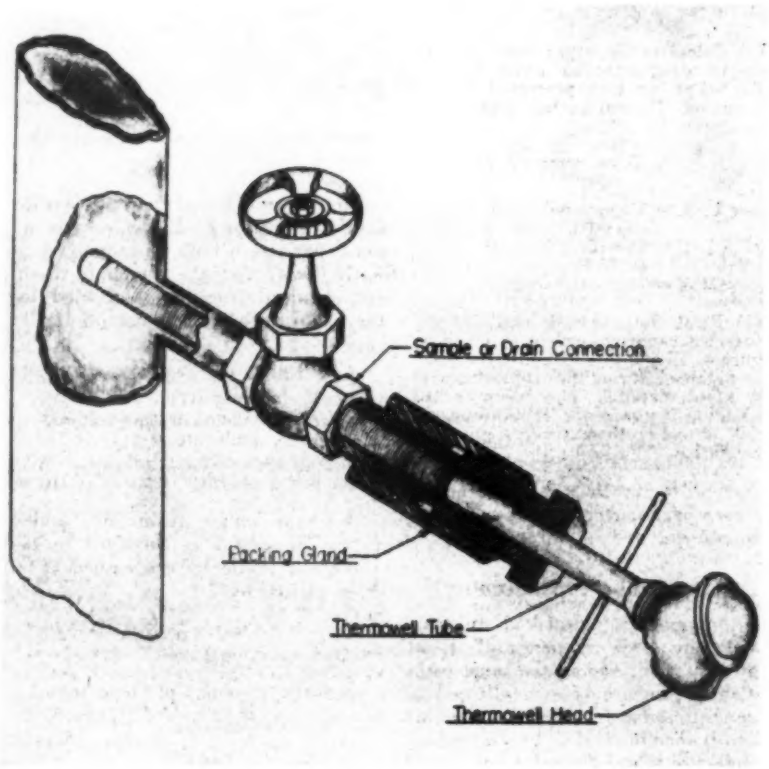


Figure 1. Cutaway view of the portable thermowell.

Description of Tube

The tube is made of $\frac{3}{8}$-inch extra heavy pipe and has a continuous thread for 20 inches along its length. The over-all length of the tube is 25 inches. The 20-inch threading on the tube will allow approximately 18 inches of penetration into the line or vessel. However, the tube can be made to any desired length. A lathe cut thread of 16 threads per inch is used on the tube described here. A finer thread could be used on the tube, and a better seal against pressure would result. However, a finer thread would require a longer time to run the tube into the line or vessel. In this case a compromise was made between sealing qualities and speed of operation. The tip of the tube is machined from solid stock and welded to the end of the tube. The weld is ground smooth to remove burrs. A $\frac{1}{8}$-inch diameter hole is drilled to a depth of 7/16-inch in the solid tip to make a neat fit between the tip and the thermocouple junction. No appreciable lag is encountered when recording varying temperatures. The solid tip is not threaded so that the tube cannot be backed out too far and blown out of the bushing. The assembly is screwed into the valve by the male pipe threads on the bushing. With the exception of a brass packing nut, stainless steel is used for construction of the device.

The thermowell has been used primarily in evaluating heat exchangers. Intermediate temperatures between several exchangers in a bank are not usually measured with any permanently installed instruments. However, most exchanger installations are equipped with several drain connections, and temperatures of inlet and outlet streams to each exchanger are obtained by inserting the thermowell in these connections. The bushing containing the packing gland is first screwed into the valve with the valve closed. The valve is then opened, and the thermowell is run into the line for temperature measurement. The thermowell is removed by reversing the procedure.

Understanding the chemistry of . . .

Petrochemical Reactions

Part 8. The Production of Olefins

Part 9. Alcohols from Olefins

Part 10. Halogenation of Olefins

Lewis F. Hatch, The University of Texas, Austin

PETROLEUM'S GREATEST contribution to the chemical industry is in furnishing the raw materials for aliphatic chemicals. In 1952, 14.3 billion pounds of aliphatic petrochemicals worth $2.2 billion were produced. This amounts to 82 percent of the total aliphatic chemical production. The most important types of aliphatic compounds are those containing hydroxyl groups (OH) in the molecule. The two main classes of hydroxyl compounds are alcohols (RCH_2OH) and glycols ($RCHOHCH_2OH$). The present article will be confined to alcohols and only to those which are synthesized from olefins by hydration.

$$RCH=CH_2 + H_2O \rightarrow RCHOHCH_3$$

This is not too restrictive for most of the alcohols produced in large quantities are made by this process.

How Are Alcohols Produced?

There are almost as many industrial methods for the production of alcohols as there are alcohols made industrially. Some alcohols are produced by as many as three or four different methods from both petroleum and nonpetroleum raw materials, and several of these methods have appeared in recent issues of the REFINER. The production of amyl alcohols from pentane through the hydrolysis of amyl chloride (Sharples Chemicals Inc.) was noted in Part 5 of this series (Chlorination of Paraffin and Aromatic Hydrocarbons—PETROLEUM REFINER, **32(9)**, 207, September, 1953).

$$C_5H_{12} + Cl_2 \rightarrow C_5H_{11}Cl + HCl$$
$$C_5H_{11}Cl + NaOH \rightarrow C_5H_{11}OH + NaCl$$

TABLE 1

Production of Various Alcohols and Related Compounds, 1952*

Compound	Formula	Production (Pounds)
Methanol (Methyl Alcohol)	CH_3OH	
Synthetic		1,098,517,000
Natural		14,853,680
Ethyl Alcohol (Ethanol)	CH_3CH_2OH	
Synthetic		858,152,000
Fermentation		*ca.* 647,000,000
Isopropyl Alcohol (IPA) (Isopropanol, Petrohol)	$CH_3CHOHCH_3$	845,932,000
n-Butyl Alcohol (Butanol)	$CH_3CH_2CH_2CH_2OH$	117,199,000
Other Butyl Alcohols	C_4H_9OH	188,483,000
Amyl Alcohols (Fusel Oil)	$C_5H_{11}OH$	991,000
Diethyl Ether (Ether)	$CH_3CH_2OCH_2CH_3$	65,162,000
Acetone	$CH_3\overset{O}{\overset{\|}{C}}CH_3$	
From IPA		403,781,000
Fermentation		35,794,000
Octyl Esters		94,190,000

* U.S. Tariff Commission.

The synthesis of methanol from methane through carbon monoxide and hydrogen was reported in the Process Section of the September, 1953, issue of the REFINER.

$$CH_4 + 1/2\,O_2 \rightarrow CO + 2H_2$$
$$CO + 2H_2 \xrightarrow{\text{cat.}} CH_3OH$$

The synthesis gas ($CO+H_2$) also comes from coke and steam (water gas). By varying operating conditions and catalyst, higher alcohols may be obtained from carbon monoxide and hydrogen—the Hydrocol process.

Other methods by which alcohols are produced commercially from petroleum are the oxo process (I), (octyl alcohols), *n*-butyl alcohol from acetaldehyde by aldol condensation, dehydration and hydrogenation, (II), and by oxidation (III). See part 4 of this series, PETROLEUM REFINER, **32(8)**, 123, August, 1953. Several alcohols are also produced by fermentation, (4), (ethyl, *n*-butyl alcohols, amyl alcohols).

I. $RCH=CH_2 + CO + H_2 \rightarrow RCH_2CH_2CHO$

$$RCH_2CH_2CHO + H_2 \rightarrow RCH_2CH_2CH_2OH$$

II. $CH_3CHO + CH_3CHO \rightarrow CH_3CH=CHCHO + H_2O$
(Crotonaldehyde)

$$CH_3CH=CHCHO + 2H_2 \rightarrow CH_3CH_2CH_2CH_2OH$$
(*n*-Butyl alcohol (Butanol))

III. $CH_3CH_2CH_2CH_3 + O_2 \rightarrow CH_3CH_2CH_2CH_2OH$ and other oxidation products

IV. $C_6H_{12}O_6 \xrightarrow{\text{fermentation}} 2CH_3CH_2OH + 2CO_2$
Glucose (Dextrose)

The acetaldehyde used in the second method may come from methane by way of acetylene or from ethylene by way of ethyl alcohol.

In spite of the multiplicity of methods employed for the production of alcohols the largest quantity is made by the hydration of olefins.

$$CH_2=CH_2 + H_2O \rightleftharpoons CH_3CH_2OH$$

Unfortunately this is an equilibrium reaction with the equilibrium at high temperatures in the direction of the olefin and water—in fact this was for a long time the method of preparing ethylene. This drawback is overcome, at least to some extent, by operating at a high pressure and at a relatively low temperature in the presence of a catalyst (Shell Chemical Corp., Texas Eastman Company Carbide and Carbon Chemicals Company) or by the use of sulfuric acid in a sulfation-hydrolysis

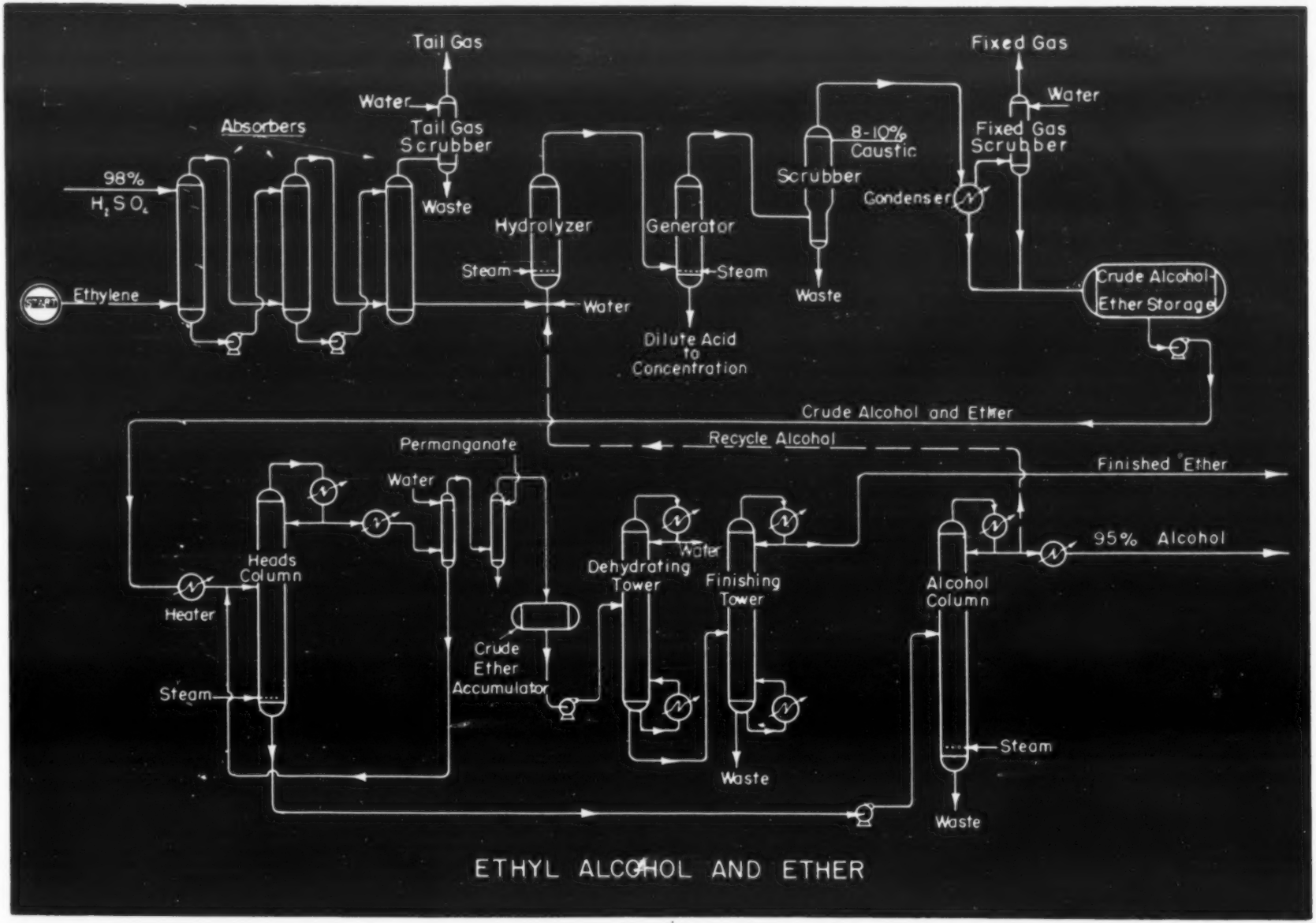


Figure 1. Production of ethyl alcohol by Sulfation

process (Esso Standard Oil Company, Carbide and Carbon, National Petro-Chemicals Company, others). The sulfation-hydrolysis process is also called the esterification-hydrolysis process for the sulfate is actually an ester of an alcohol and an inorganic acid.

There are two inherent disadvantages to the production of alcohols by the hydration of olefins. There is always a certain amount of by-product ether, and with propylene and higher olefins only secondary and tertiary alcohols are formed. This is not good, for, in general, primary alcohols (RCH_2OH) are of more value.

$$CH_3CH=CH_2 + H_2O \rightarrow CH_3CHOHCH_3$$

Isopropyl alcohol
A secondary alcohol

$$CH_3C(CH_3)=CH_2 + H_2O \rightarrow CH_3C(CH_3)OHCH_3$$

tert. Butyl alcohol
A tertiary alcohol

Sulfation-Hydrolysis Process

The preparation of alcohols from olefins by the use of sulfuric acid is a three step process.

1. Absorption of the olefin in concentrated sulfuric acid *(Sulfation)*.

$$RCH=CH_2 + H_2SO_4 \rightarrow RCHCH_3$$

OSO_3H

Alkyl hydrogen sulfate

2. Dilution and hydrolysis of the alkyl hydrogen sulfate *(Hydrolysis)*.

$$RCHCH_3 + H_2O \rightarrow RCHOHCH_3 + H_2SO_4$$

OSO_3H

3. Reconcentration of the dilute sulfuric acid.

Step 3 will not be considered here, although, from the standpoint of economics, the reconcentration of the dilute sulfuric acid is very important.

Sulfation. Absorption of the olefin in sulfuric acid is carried out using acid concentration ranges from about 50 percent to 98 percent and temperature ranges from near zero to 30 C. (Table 2).

The ease of sulfation increases in the order ethylene< propylene<*n*-butylenes<isobutylene, and this difference in reactivity has been used to separate the various olefins. The absorption is carried out under pressure and in either the liquid phase or vapor phase.

There are three side reactions: The formation of ethers, polymers and dialkyl sulfates. Polymer formation is directly related to the ease of sulfation, and, when the minimum conditions for sulfation are maintained, polymerization of the olefin does not become serious. Ether formation always occurs but can be reduced to a low figure (*ca.* 5 percent) by operating under conditions disadvantageous to dialkyl sulfates which are thought to be the precursers of the ethers. Formation of dialkyl sulfates is promoted by increased pressure or concentration of olefin, increased concentration of the acid and by a high olefin-acid ratio. The dialkyl sulfates not only cause an increase in ether formation but also are more difficult to hydrolyze to the alcohol.

Hydrolysis. The alkyl hydrogen sulfates are hydrolyzed by dilution with water and heating. When relatively dilute acid is used, there is a considerable amount of alcohol in the reaction mixture even before dilution. The extent of dilution is controlled by two factors. First the dilution must be sufficient to prevent the dehydration of the alcohol back to the olefin when the reaction mixture is heated. Secondly, the dilution is limited by the economics of reconcentrating the dilute acid for reuse.

The alcohols are usually distilled out of the dilute acid solution and then concentrated to the composition of their water azeotrope. Anhydrous alcohols are produced by further azeotropic distillation using a third component which either forms a lower boiling binary azeotrope with water or a ternary azeotrope containing only a small amount of the alcohol.

Catalytic Hydration of Olefins

The catalytic hydration of olefins may be represented as an addition of a water molecule to an olefin and results in the direct formation of an alcohol.

$$RCH=CH_2 + H_2O \rightarrow RCHOHCH_3$$

It is more likely, however, that there is an intermediate formed similar to alkyl hydrogen sulfate which, in turn, hydrolyzes to the alcohol and regenerates the catalyst.

At first glance catalytic hydration of olefins would seem to have much to offer in competition with the sulfation process. There are some drawbacks, however, for the process requires a more pure olefin than the sulfation process and operates at a higher temperature and pressure. It may be carried out either in the liquid or vapor phase with solid or liquid catalysts. Actually only two or three companies are using a catalytic process and only for the production of ethyl alcohol. It is thought that an acid phosphate catalyst is used at about 100 C. and at a high pressure (1000 psig). The conversion is low, but the yields are said to be high.

What Is the Reaction Mechanism?

There have been a number of reaction mechanisms proposed for the hydration of olefins in an aqueous acid medium. The latest and in many respects the best is that of Robert W. Taft, Jr., of Pennsylvania State College. The following equations represent the proposed sequence of reactions.

$$V. \quad -\overset{|}{C}-\overset{|}{C}- + H_2O \overset{fast}{\rightleftharpoons} \left[-\overset{|}{C}-\overset{H}{\overset{|}{C}}- \right]^+ + H_2O$$

A

$$VI \quad \left[-\overset{|}{C}-\overset{H}{\overset{|}{C}}- \right]^+ \overset{slow}{\rightleftharpoons} \left[-\overset{|}{C}-\overset{|}{\underset{H}{C}}- \right]^+$$

B

$$VII \quad \left[-\overset{|}{C}-\overset{|}{\underset{H}{C}}- \right]^+ + 2H_2O \overset{fast}{\rightleftharpoons} -\overset{|}{C}-\overset{|}{\underset{H}{C}}- + H_3O^+$$

OH

Reaction V is an equilibrium and the proton (H^+) is associated with the *pi* electrons of the carbon-carbon double bond and not with either carbon atom. Reaction

TABLE 2
Acid Concentrations and Temperatures for the Sulfation of Various Olefins

Olefin	Formula	Acid Conc. Range, Percent	Temperature Range C.
Ethylene	$CH_2=CH_2$	90-98	60-80
Propylene	$CH_3CH=CH_2$	75-90	25-30
Butylenes	$CH_3CH=CHCH_3$	75-85	15-30
	$CH_3CH_2CH=CH_2$		
Isobutylene	$CH_3C(CH_3)=CH_2$	50-65	0-25

VI is rate controlling and represents the isomerization of the carbonium ion A to the carbonium ion B which has the proton covalently bonded to one of the carbon atoms, and the other carbon atom now carries the positive charge. Reaction VII is fast and yields the alcohol.

This mechanism explains both the acid catalyzed hydrolysis of the more reactive olefins (such as isobutylene) and the fact that dilution of a concentrated acid absorption mixture results in the immediate liberation of a large quantity of alcohol whereas alkyl hydrogen sulfates hydrolyze slowly. Some of the alcohol is present in the form of the carbonium ion while the rest is in the form of the sulfuric acid ester. The relative amounts of each is determined by the acid concentration and the nature of the olefin.

What About Ethyl Alcohol?

The question has many facets, for ethyl alcohol is not only a very important industrial chemical but also a beverage from which the government makes appreciable income by taxation. It may be synthesized from petroleum products by several different methods and obtained by fermentation from farm products and molasses. It is little wonder that what is soberly said about ethyl alcohol today may sound the next day as coming from one who has been too close to his subject. To add to the confusion one has only to note that production figures are given in pounds, gallons, wine gallons and proof gallons. One hundred percent ethyl alcohol *(absolute alcohol)* is 200 proof and one wine gallon of 190-proof alcohol equals 1.9 proof gallons—if any further proof is needed.

The percentage of ethyl alcohol produced from petroleum has increased steadily during the last few years. In 1939 molasses furnished 68 percent of our industrial alcohol and 24 percent was synthesized. In 1948 the figures were 39 percent and 38 percent; while, in 1952, 57 percent of the industrial alcohol production was of petrochemical origin. The figure for 1953 is approximately 65 percent. Approximately 70 percent of this synthetic alcohol production is captive. The percentage increase in synthetic ethyl alcohol production is caused both by the building of new synthetic alcohol plants and shutting down of fermentation facilities (E. I. du Pont de Nemours & Company, U. S. Industrial Chemicals Company). In recent years the wide fluctuations in price and supply of industrial alcohol have been caused by similar wide variations in the price and availability of Cuban molasses. The swing toward synthetic alcohol has led to an increased stability in the alcohol industry.

Ethyl alcohol goes into many industrial chemicals with oxidation to acetaldehyde leading the list. Many ethyl esters are used for solvents (ethyl acetate—61,441,000 pounds in 1952) and ethyl alcohol itself is used both as a solvent and an antifreeze. The reactivation of the ethyl alcohol process for the production of butadiene for synthetic rubber will completely change the alcohol picture.

Figure 1 gives a flow diagram of a typical sulfation process unit for the production of ethyl alcohol.

Why So Much Isopropyl Alcohol?

There are several answers to that question, with one of the more important ones being that isopropyl alcohol *(IPA)* may be used in many places as a substitute for ethyl alcohol, and for these uses it has the distinct advantage of being alcohol-tax free and thus not subject to regulation. The major use of isopropyl alcohol is in the production of acetone by dehydrogenation (VIII) and oxidation (IX).

$$\text{VIII. } CH_3CHOHCH_3 \xrightarrow{\text{cat.}} CH_3\overset{O}{\overset{\|}{C}}CH_3 + H_2$$

$$\text{IX. } CH_3CHOHCH_3 + 1/2\,O_2\,(\text{air}) \xrightarrow{\text{cat.}} CH_3\overset{O}{\overset{\|}{C}}CH_3 + H_2O$$

Isopropyl alcohol is also used as a solvent, dehydrating agent, antifreeze and as rubbing alcohol (70 percent isopropyl alcohol). It is not potable.

Isopropyl alcohol has the distinction of being the first petrochemical (1920) although at that time it was called a synthetic organic chemical. It was produced by the hydration of propylene using the sulfuric acid absorption-hydrolysis process still used today. This process is very similar to that used for ethylene but operates under milder conditions. Propylene rich gases are passed up a packed tower at 21 to 27 C. Sulfuric acid (85 percent) is introduced at the top of the tower and passes downward countercurrently to the propylene gases. The exothermal reaction is controlled by cooling. Under these conditions any ethylene in the gases remains unabsorbed, but the higher olefins (butylenes and pentenes) are absorbed.

The reaction mixture is diluted in a lead-lined dilution tank to a 20 percent acid concentration. The heat of dilution plus added steam drive off the crude alcohol. This alcohol is concentrated to its water azeotrope (91 percent isopropyl alcohol) in a conventional column. Absolute isopropyl alcohol (99 percent) is obtained by distillation of the 91 percent alcohol with diisopropyl ether. A ternary azeotrope is formed with the following composition: 91.1 parts diisopropyl ether, 5.8 parts isopropyl alcohol, 3.1 parts water. This ternary boils at 61.4 C.

Isopropyl alcohol is made by Shell, Enjay Company, Inc, (Esso), and Carbide and Carbon. Oxidation is essentially the only source of *n-propyl alcohol* (Celanese Corporation of America).

Higher Molecular Weight Alcohols

The production and uses of *n-butyl alcohol* ($CH_3CH_2CH_2CH_2OH$) were discussed in Part 4 of this series. *Secondary butyl alcohol* ($CH_3CHOHCH_2CH_3$) is produced by the hydration of either 1-butene or the 2-butenes (Shell, Enjay). The process is similar to that used for the production of isopropyl alcohol from propylene, but the conditions are less severe. Almost the entire production of *sec.* butyl alcohol is used in the production of methyl ethyl ketone *(MEK)*, a medium boiling solvent. It is also used as a solvent and in miscellaneous synthesis. *Isobutyl alcohol* ($[CH_3]_2CHCH_2OH$) is primarily a by-product of the synthesis of methanol and is used to some extent as an intermediate in the manufacture of fine chemicals and as a component of hydraulic-brake fluid. *Tertiary butyl alcohol* ($[CH_3]_3COH$) is readily formed by the hydration of isobutylene (Shell) but is of little industrial importance.

Isoamyl alcohol, *n-amyl alcohol* and *mixed amyl alcohols* (fusel oil) are obtained by fermentation (Commercial Solvents Corporation, Publicker Industries, U. S. Industrial Chemicals Company) while the Sharples process from mixed pentanes yields all of the isomers except isoamyl alcohol. The amyl alcohols are used as solvents and for the synthesis of fine chemicals and pharmaceuticals. The higher alcohols, especially *isooctyl alcohol* (Enjay, Indoil Chemical Company), are not produced from olefins by hydration but by the oxo-process. Their esters are used as plasticizers.

The November, 1953, Petrochemical Issue of the PETROLEUM REFINER contains a process description and flow diagram for the production of ethyl and isopropyl alcohols from the corresponding olefins by hydration.

End of Part 9. Part 10 will appear in an early issue.

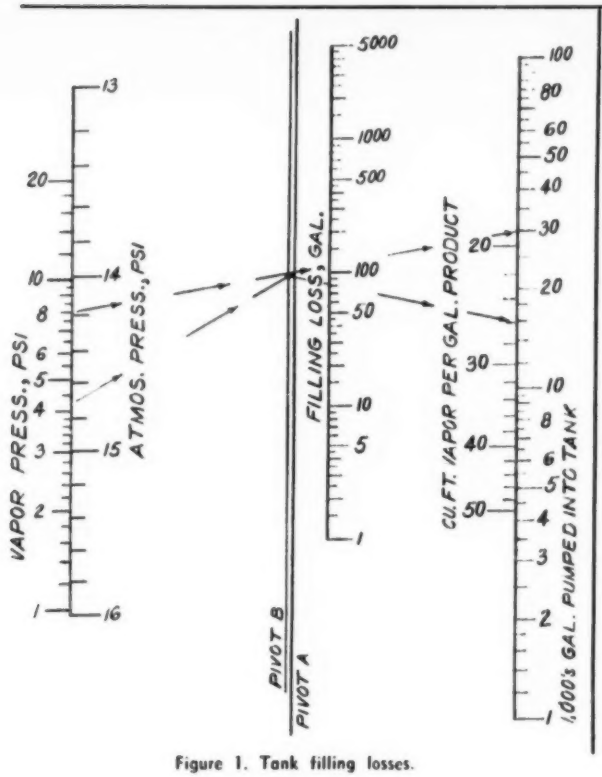


Figure 1. Tank filling losses.

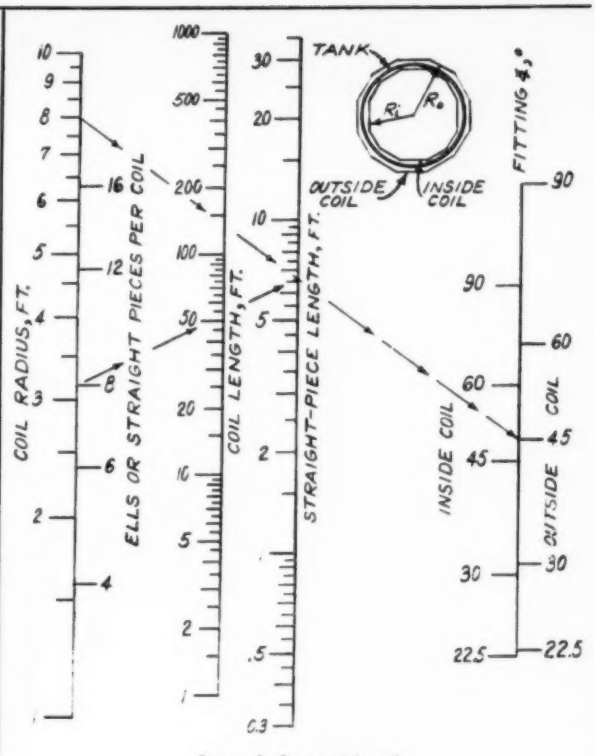


Figure 2. Pipe-coil length.

Use these charts to . . .

Simplify Refinery Calculations

- Save time in planning
- Reduce slide-rule errors
- Check field values quickly

Louis J. Murphy,
International Engineering Associates,
New York

THE ACCOMPANYING charts cover many phases of refinery and petrochemical plant design and have proven themselves to be excellent time savers during any planning work. They also are helpful to plant operators desiring to check values in the field. So if you wish to save time and labor learn how to use the charts on the job. They'll keep that decimal point in the right place, reduce slide-rule errors and give you greater confidence in your results.

1. Estimate Fixed-Roof Tank Filling Losses

Filling and breathing losses during storage of petroleum products in fixed-roof tanks are a function of product vapor pressure, thruput or number of gallons of product pumped into the tank, atmospheric pressure, and number of cubic feet of vapor formed by evaporation of one gallon of the product. This chart correlates all these factors and is suitable for all normal storage conditions in fixed-roof tanks. Where product temperature or vapor pressure is excessively high, results from the chart will be about 10 percent below actual loss. However, in the usual refinery an error of this magnitude is unimportant because storage

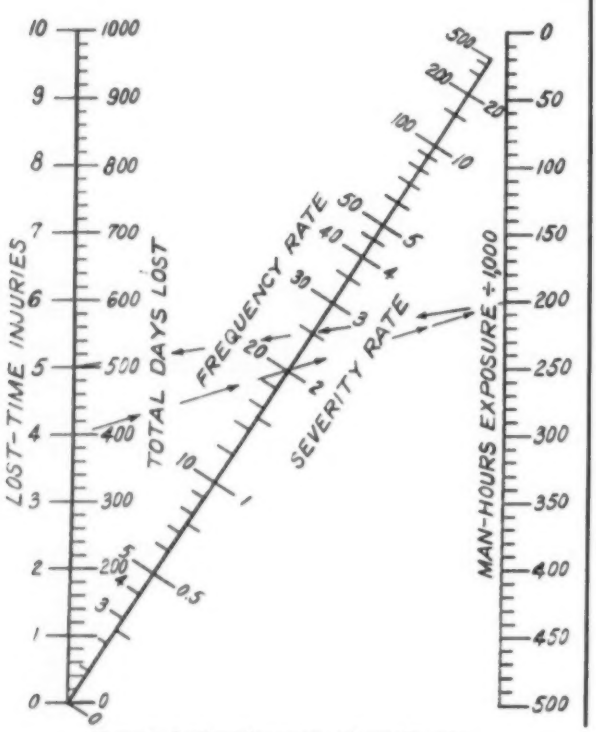


Figure 3. Accident frequency and severity rates.

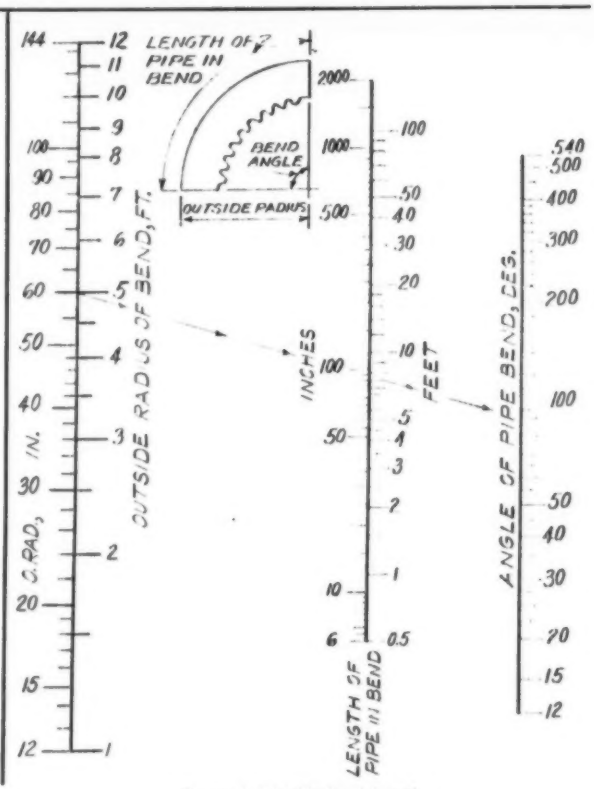


Figure 4. Wrinkle-bend length.

of products at excessive temperatures or with high vapor pressure (unstable stock) is not common practice.

Problem: What is the filling loss during the period while 30,000 gallons of a product having a vapor pressure of 8 psia are pumped into a tank if the atmospheric pressure is 14.7 psia and the product forms 26 cubic feet of vapor per gallon evaporated?

Answer: Enter the chart at the left at the product vapor pressure, 8 psia, and draw a straight line through 30,000 gallons pumped, on the right. From the intersection of this line with Pivot A draw a second line through the atmospheric pressure of 14.7 psia, on the left. Lastly, connect the intersection of the second line with Pivot B with 26 cubic feet of vapor per gallon, on the right. Read the filling loss as 83 gallons on the filling loss scale.

Note that you can find any variable plotted on this chart if you know the other four. By keeping this fact in mind you can use the chart to solve a large number of practical problems.

This chart is based on the relation: $L = VT/7.5(PC)$, where L = filling loss, gallons; V = product vapor pressure at tank temperature, psia; T = thruput, gallons; P = atmospheric pressure, psia; C = cubic feet of vapor formed by evaporation of one gallon of product.

2. How to Determine Pipe-Coil Length

Heating, fire-protection or feed pipe coils may be run inside or outside vertical cylindrical tanks, as shown on the sketch on this chart. To determine the amount of heat transferred, how much protection is offered, or the cost of the pipe, its length must be known. This chart permits rapid estimates of pipe length for a large number of fitting angles and tank radii.

Problem: What is the length of each straight piece and the total length of a pipe coil around the outside of a 16-foot diameter tank if 45° ells are used to make up the coil?

Answer: Enter the chart at the left at a radius of 8 feet (= 16 feet dia/2) and draw a straight line through the 45° fitting angle for an outside coil on the right. On the straight-piece scale read the straight length as 6.6 feet. Now, the number of ells or straight pieces per coil = 360°/fitting angle, or 360/45 = 8. So from eight ells or straight pieces on the left draw a straight line through the intersection of the first line with the straight-piece scale. Read total coil length as 53 feet on the second scale from the left.

Where tank radius exceeds 10 feet, divide the radius by a convenient number and solve as above. Then multiply the result by the number divided into the radius. For instance, in the above problem if the radius were 80 feet, divide by 10 and solve as described, entering the chart at a radius of 8 feet. Then multiply each result by 10 to obtain a straight-piece length of 66 feet and a total length of 530 feet.

This chart is based on the geometrical relations for the various fitting angles indicated and is accurate enough for all usual length and cost estimates.

3. How to Check Refinery Safety Records

Records of refinery accidents are excellent guides to the amount of attention that must be paid to a personnel safety program. Unevaluated records, however, do not tell much of a story. Only when the record for your plant is compared with others doing similar work can you determine how well or how poorly your safety campaign is going over.

This chart permits you to evaluate frequency and severity rates—the two indicators of safe operation, or lack

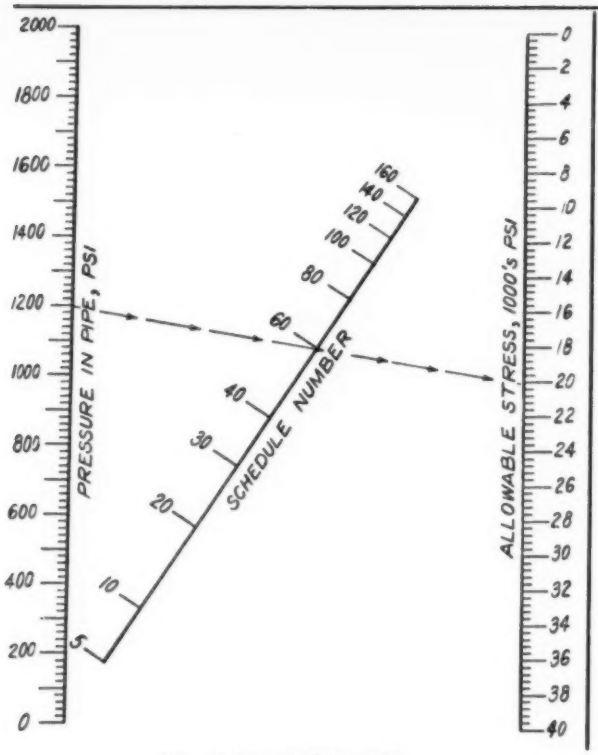


Figure 5. Pipe schedule number.

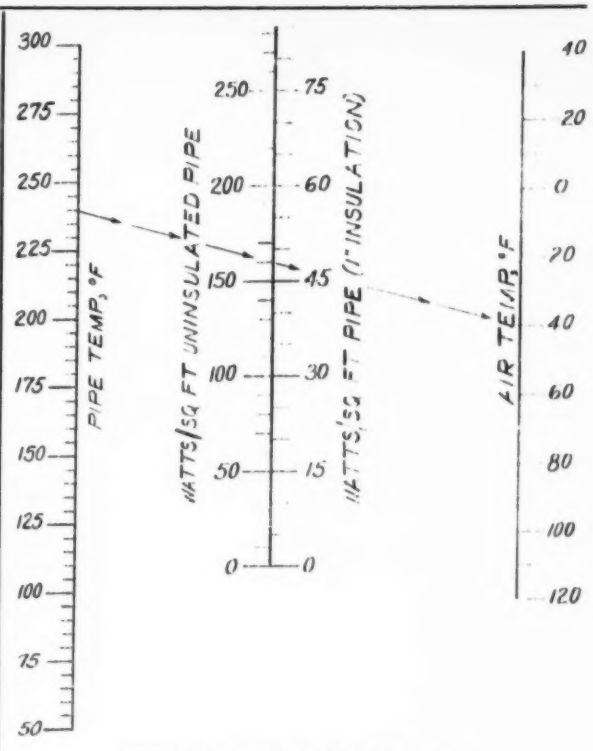


Figure 6. Electrical heating of refinery pipes.

of it. The National Safety Council publishes frequency and severity rates for a large number of industries in the U. S. By comparing your rates with those for other refineries you can easily determine if your personnel safety program is having the desired results.

Problem: A refinery had four lost-time injuries to personnel during 200,000 man-hours exposure. What are the frequency and severity rates if 500 days were lost due to the injuries?

Answer: Enter the chart at the left at four lost-time injuries and draw a straight line through 200,000 hours exposure on the right. At the intersection with the central scale read the frequency rate as 20. Then from 200,000 hours on the right draw a straight line through 500 days on the left and read the severity rate as 2.5.

This chart is based on: frequency rate = (lost-time injuries) (10^6)/man-hours, and severity rate = (days lost) (10^3)/man-hours. Use it today to see how your plant stacks up with similar ones throughout the U. S. If your safety record is poor, get to work to improve it.

4. Quick Figuring of Wrinkle-Bend Length

Wrinkle bends find much use in refineries and petrochemical plants where pipe expansion and stress are problems. They often permit elimination of expansion joints or reduction in the amount of space required for a bend to absorb expansion. One problem faced when designing or estimating these bends is the amount of pipe needed to make it. This chart solves that problem quickly and easily for the complete range of bends commonly used.

Problem: How much pipe is needed to make a wrinkle bend having an outside radius of 5 feet if bend angle is 90°?

Answer: Enter the chart at the left at the outside radius of 5 feet and draw a straight line through 90° on the right. At the intersection with the central scale read the length as 94 inches, or 7 feet 10 inches.

Note that you may use this chart for bends from 12 to 540°, the most common range used in refineries. The chart is based on the geometric properties of bends in this range.

5. Simple Determination of Pipe Schedule Number

Refinery pipe designers now universally use the schedule-number method for determining pipe-wall thickness because it saves time, effort and money. Pipe chosen this way is easier to specify and obtain. The only real objection to the schedule-number method is that it requires considerable time to apply, especially when a number of different classes of pipe operating at varying temperatures must be chosen. This chart cuts design time and permits easy observation of the effect of temperature and pressure on pipe-wall thickness. All you need use with it is a table of allowable stresses for different pipe materials at various temperatures. This is obtainable in any piping catalog and in the ASA *Code for Pressure Piping*.

Problem: What schedule pipe should be used for a refinery line operating at 1200 psi if Grade C API 5L electric resistance welded steel is specified, and allowable stress at the operating temperature (from *Code* or catalog) is 20,050 psi?

Answer: Enter the chart at the left at the operating pressure of 1200 psi and draw a straight line through 20,050 psi on the right. At the intersection with the central scale read the schedule number as 60.

This chart is based on $N = 1000 (P/S)$, where N = schedule number, P = operating pressure, psi, S = allowable stress in pipe, psi, from *Code*. When using the chart be sure to choose the allowable stress at the operating temperature of the pipe. Use the latest

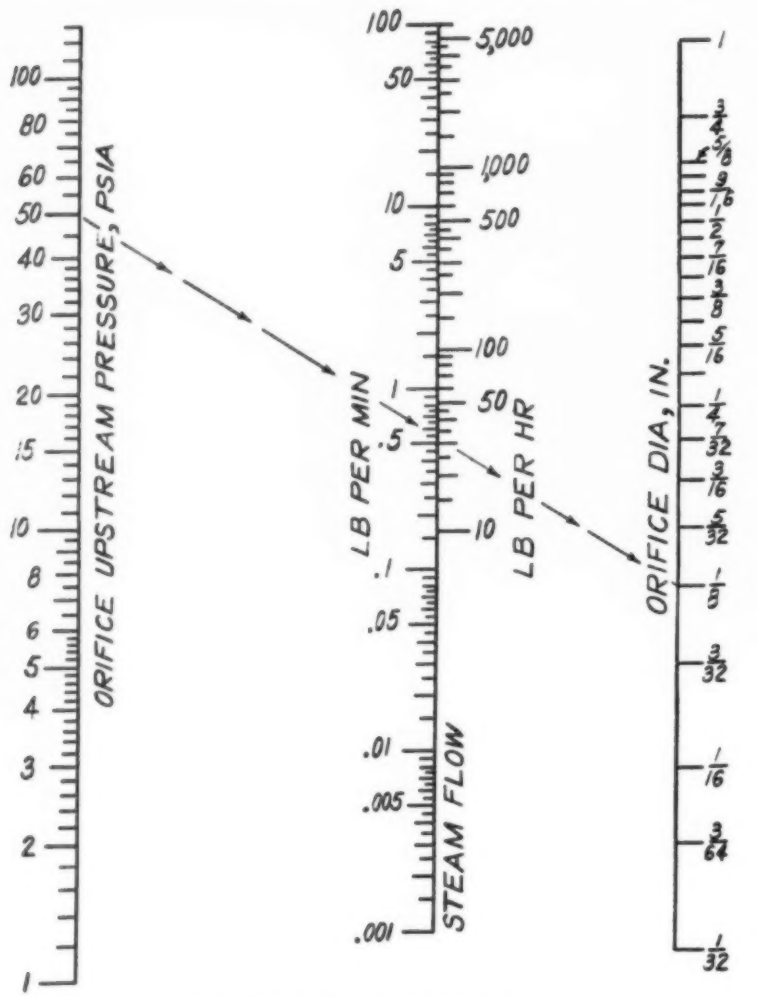


Figure 7. Steam flow through orifices.

copy of the *Code* to determine correct stress.

6. Electric Heating for Refinery Pipes

Electric heating cable has replaced steam tracing of refinery lines for many different applications. Advantages claimed for electric tracing of refinery pipes include easy control, ease of concentrating heat at any desired point, flameproof, and elimination of any effects the site might have on the design of a steam-traced system. The accompanying chart permits accurate estimates of the amount of electric energy required to heat refinery pipes under different operating conditions.

Problem: How much energy is required to heat each square foot of a refinery pipe that is to be maintained at a temperature of 240 F. if lowest outdoor temperature encountered at the site is 40 F.?

Answer: Enter the chart at the left at a pipe temperature of 240 F. and draw a straight line through 40 F. on the right. At the intersection with the central scale read the energy required as 160 watts per square foot for uninsulated pipe and 48 watts per square foot for pipe having insulation 1 inch thick. To find the total amount of energy needed to keep the pipe at 240 F., multiply total heated-pipe area in square feet by the watts per square foot required for heating.

Always use the lowest atmospheric temperature expected when entering the chart. This is usually the lowest winter temperature in the area.

7. Steam Flow Through Orifices

Where a steady flow of steam is required to process and other operations an orifice is often substituted for other control devices because its first cost is low and maintenance is negligible. This chart permits accurate sizing of orifices for a large range of flow rates and upstream pressures. It is based on Napier's equation for conditions where the absolute downstream pressure is less than 0.58 times the absolute upstream pressure.

Problem: How much saturated steam will flow through a $\frac{1}{8}$-inch diameter orifice if the absolute upstream pressure is 50 psia?

Answer: Enter the chart at the left at the upstream pressure of 50 psia and draw a straight line through $\frac{1}{8}$-inch diameter on the right. At the intersection with the central scale read the flow as 0.528 pounds per minute, or 31.6 pounds per hour.

Note that this chart is based on saturated steam. Where the steam entering the orifice is superheated, a correction factor must be applied. The same is true for wet steam. Correction factors for these conditions can be found in any standard mechanical engineer's handbook.

Reprints Of Value

Petroleum REFINER has available a limited number of reprints on the subjects listed:

17. "A New Approach To Tray Design" Askel C. Field $ .25

26. "Extractive Crystallization —A New Separation Process, Kenneth A. Kobe, William G. Domask .50

31. "Thermal Insulation for Industrial Requirements" Ray Thomas 1.00

36. "Symposium-Economics and Cost Estimating," J. F. Gilmore, Jr., J. P. Hamilton, A. B. Horn, F. G. Sergeys, W. C. Strader, Harold Bottomley .50

Please order by number, sending cash or check with order.

Reprint Department
PETROLEUM REFINER
Box 2608 Houston 1, Texas

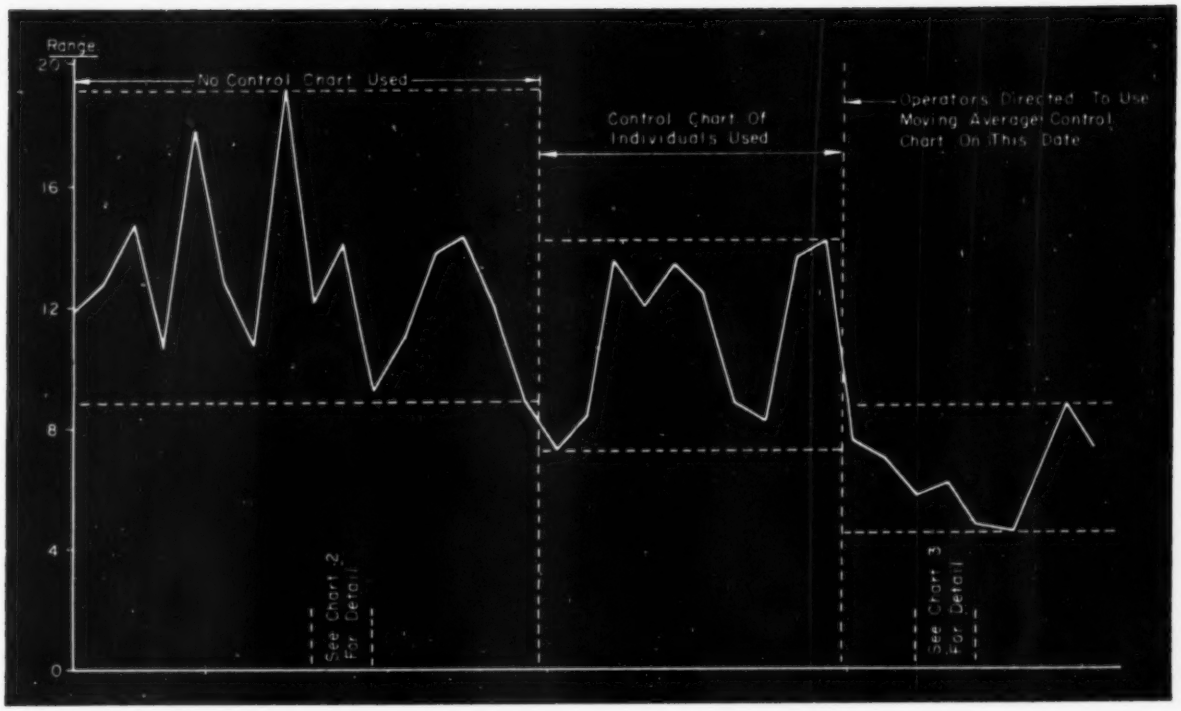


Figure 1. Averages of groups of five ranges of four samples.

A demonstrated success . . .

Statistical Quality Control

◗ Application of this tool to a fractionating tower has reduced product quality variability.

◗ Fewer process adjustments were necessary when the process was in the state of statistical control.

John F. Walter,
University of Pittsburgh,
Pittsburgh, Pa.

STATISTICAL QUALITY control in a petroleum refinery calls for a technique to control the continuous stream type of process. The principles involved also have application in large chemical plants and wherever there are extensive fluid operations.

An experiment was carried on in a large refinery over a period of several months, and the indications were that statistical control of a continuous fluid process can reduce the variability of product quality considerably. In these terms statistical quality control is a demonstrated success.

The project was initiated as a result of examining sampling schedules for a refining unit. These schedules were originally established to satisfy the demands of conservatively minded operating men by calling for regular and frequent sampling. Attempts at economy in laboratory operation exerted a pull in the other direction, looking toward longer intervals between samples. In an effort to resolve this conflict and to establish acceptable standards of sampling frequency, applications of statistical quality control were investigated. It was assumed that a process operating in statistical control is a prerequisite to determining optimum sampling schedules.

Fractionating Tower Used

The unit selected for experimentation was a fractionating tower with an average daily run of 62,000 barrels. The top stream coming off this tower turns out 20,000 to 23,000 barrels per day. This was the stream chosen. Product samples were drawn from the line at eight-hour intervals.

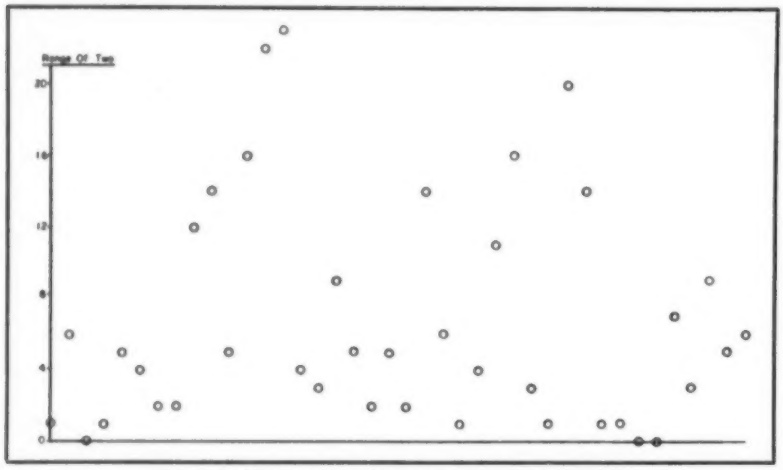


Figure 2. Moving range of two (no control chart used).

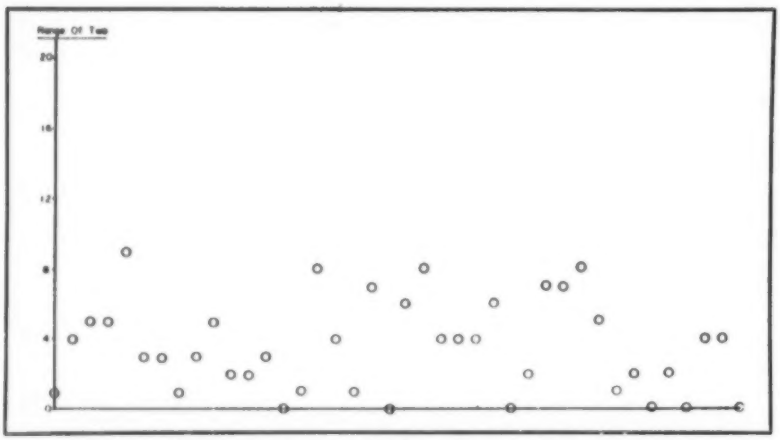


Figure 3. Moving range of two (moving average control chart used).

Ready-made procedures could not be found in the literature of quality control. At the most, hints were given that helped to point the way in the right direction. In fact, during the 1940's some academic and industrial statisticians were known to have said that statistical quality control had no place in the chemical industry. Owen L. Davies, in his *Statistical Methods in Research and Production with Special Reference to the Chemical Industry*, 1949, says of quality control, "Its application in the wider field of the chemical industry is still a matter of some doubt, but in view of its striking success in other fields, it is felt that the possibility of its application to chemical plants should receive careful consideration." As recently as February, 1953, L. J. McGovern, writing in PETROLEUM REFINER, said that to his knowledge there have been no successful direct applications of statistical quality control to petroleum processing units. He said further, "The development of this approach is still on the drawing board." Thus, it can be seen that pioneering activities were necessary in the year of 1953. A start was made with only the assurance that no harm could result from the attempt.

Improved quality control presents other than technical problems. Some operating men, long accustomed to established procedures and having a conservative attitude toward their work, are slow to accept new ideas. It is only natural that people take pride in what they have done for a long time. Unfamiliarity may also cause resistance to develop when new terms are introduced from the field of statistics.

Obtaining Samples

The usual average and range charts require modifications when applied to a continuous stream. In metal-working industries five or ten samples at a time may be taken off the assembly line for inspection to determine their average quality. It is meaningless to average several samples drawn at one time from a fluid product stream. Fluids are homogeneous in nature, so each sample will be the same as another. Such averages would not be sampling averages. They would represent an averaging of laboratory test results, tending to eliminate measurement error. In this event, product quality is not being averaged by the statistician. Averaging becomes instead a chemical reaction.

To get a sampling average it is necessary to take the samples at different periods of time. If the intervals between samples are short, it comes close to being like the situation where two or more samples are drawn simultaneously. If they are farther apart, one is forced to wait some time after taking the first sample before final reports are forthcoming. This delay may be too long to satisfy operating requirements.

A chart of individuals gives quick results, but with certain other disadvantages. It lacks the smoothing effect of an average chart (see Figures 4 and 5 which present the same information in both forms). This smoothing out of short-term fluctuations permits more careful determination of the real process level. In addition, laboratory analytical error creates more uncertainty for any single sample than for an average of several samples. To say the same thing in another way, multi-testing increases the reliability of laboratory tests. Sampling error is affected in a similar way.

As a compromise between the chart of individuals and the chart of averages, a moving average was plotted. This seems to combine all the advantages of the average with some of the desired sensitivity to change. It even smoothes out the curve more than an average does. While not quite so responsive to change as the chart of individuals, it is, perhaps, desirable not to be. On the other hand, the moving average does respond to each new test result incorporated into the average. Basically, the average chart is the guide to process level, while process variability can be better portrayed by a chart of ranges or standard deviations, a moving range of two samples being useful (see Figures 2 and 3).

How many samples should be included in the subgroup for the moving average? This is a debatable point. In the experiment under consideration a moving average of four was used. Averages of four are statistically more effective than averages of two or three. Distributions of averages of four or more tend to be normal, while the

larger averages have less sensitivity to change.

Control limits are established in much the same way as in other kinds of quality control work. However, since there is no rational subgroup basis for computing ranges as a measure of process variability, the alternative is to form groups out of samples taken in consecutive order. From 25 to 50 groups are used. Factors from published tables of multipliers may be applied to the average range to get the desired control limits. Typical data from this experiment are given in Table 1.

It is reasonable to look for some improvement when the chart is first installed, not knowing how much improvement can be made, of course. In the experimental project an arbitrary squeeze was put on the control limits by starting with 80 percent rather than 3 sigma limits. Success in staying within these limits proved the decision to be justified. Later 3 sigma limits were used, but by then these limits were narrower than the original 80 percent limits.

The Critical Control

Final boiling point on a distillation test was the critical control. Prior to beginning statistical quality control the process had a standard deviation

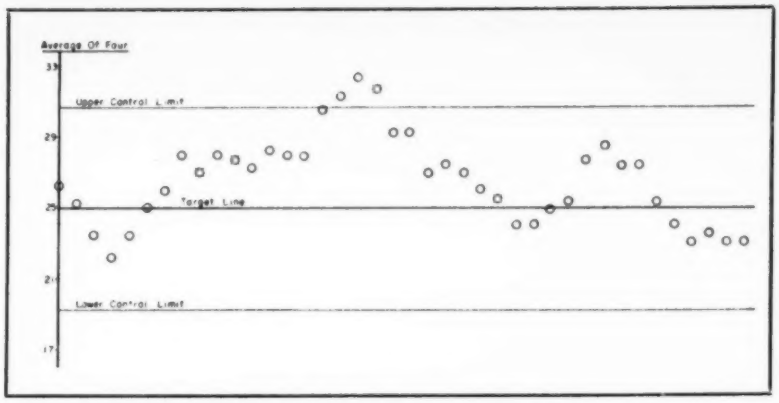


Figure 4. Control chart—moving average of four.

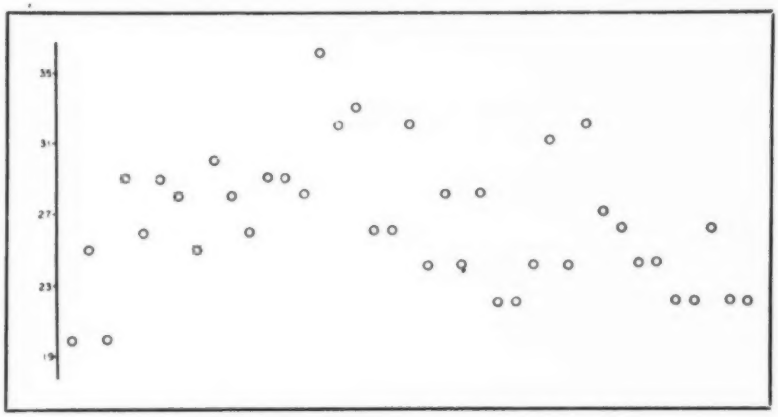


Figure 5. Individual samples (moving average control chart used).

TABLE 1

25		29		31		20		24			
32		27		24		26		25			
28		27		32		28		24			
42	6	27	2	27	8	27	8	18	7		
32		26		26		26		26			
43		28		24		26		15			
46		29		24		28		21			
20	26	34	8	22	4	27	2	19	11		
24		30		22		26		21			
35		24		26		26		20			
32		31		22		25		20			
28	13	25	7	22	4	26	1	20	1		
22		24		28		25		23			
30		30		24		22		26			
30		25		32		30		28			
30	2	30	5	26	6	30	10	24	5		
32		26		24		24		14			
30		26		30		24		17			
21		29		30		22		23			
24	12	28	3	30	4	23	2	14	9		
24		25		24		22		14			
26		30		22		22		22			
24		28		24		24		16			
27	3	26	5	26	4	22	2	16	8		
25		29		26		29		14			
26		29		23		26		18			
36		28		24		19		14			
27	11	36	8	27	3	26	10	23	9		
26		32		28		18		19			
28		33		29		19		19			
27		29		24		26		16			
33	9	26	7	27	5	26	8	15	4		
26		32		27		32		Total 329			
27		24		20		20		Average 6.85			
29		29		28		28		(2.282) (6.85) = 15.6			
25	4	24	8	24	8	34	14				
23		28		24		20		Exclude 26			
29		32		29		22		Total 303			
28		32		22		28		Average 6.45			
36	13	24	6	25	3	18	10	(2.282) (6.45) = 14.7			

3 Sigma Control Limits for Averages (0.729) (6.45) = 4.70

of 6.2 degrees over a period of 15 weeks. Then, for a ten-week period a control chart of individuals was used with a standard deviation of 5.0 resulting. Finally, a moving average control chart applied over a period of nine weeks produced a standard deviation of 3.1. The moving average reduced variability to one-half of what it had been without statistical quality control (see Figure 1). These gains were made without using a range chart, showing the effectiveness of a chart of individuals and then of a chart of the moving average uncomplicated by other considerations.

Reduction in variability of the product stream has several consequences. The immediate objective is to attain a desired cut point. This ultimately becomes a question of meeting customer specifications with greater accuracy, avoiding some degree of former quality giveaway. When applied to intermediate stages of production, statistical quality control means less difficulty with subsequent operations as a result of stabilizing their feed. In the fractionating tower itself adjoining streams will have less variability as a result of stabilizing the one stream.

In other industries statistical quality control has made it possible to abandon 100 percent inspection without any sacrifice of quality. There is no such thing as 100 percent inspection in a continuous fluid process, but the amount of inspections can be less with statistical quality control than without control. During the course of the experiment it was possible on two occasions to test more than 60 samples without making a single process adjustment. In the state of statistical control that this condition represents, fewer samples could have been taken without disadvantage. Twenty samples would have served as well as 60, or one per day instead of one each shift. The laboratory reports that a reduction of two samples a day would mean a saving of about $3000 per year in laboratory costs. Any such reduction is feasible only while the process is in control. Special samples are required more frequently during an upset.

Try Different Arrangements

It appears as though the only way to determine the right number of samples is to try different possible arrangements and judge by the results.

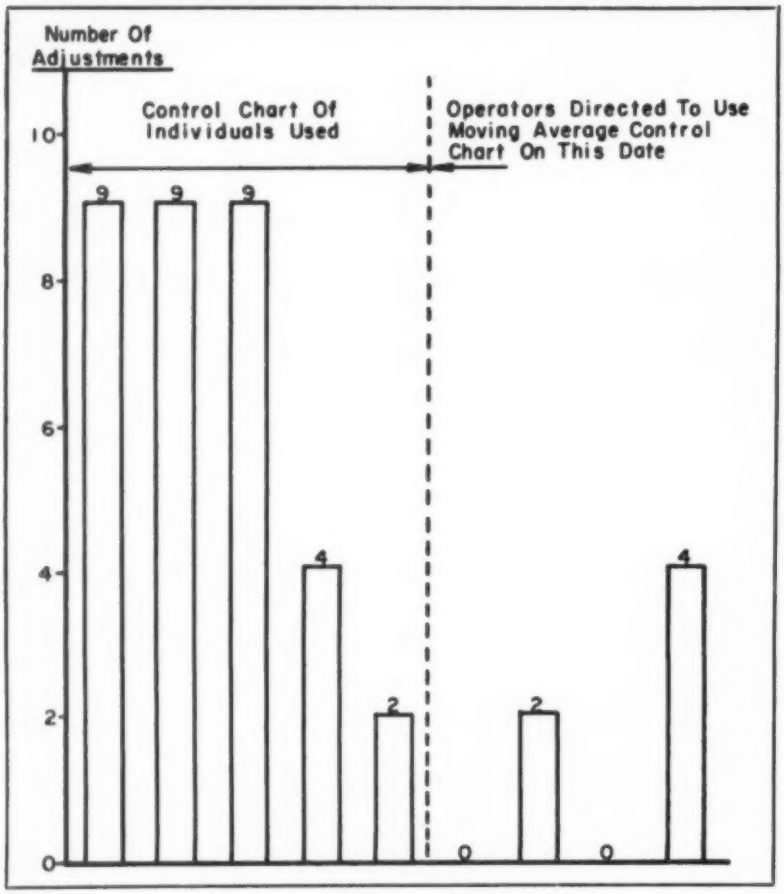


Figure 6. Process adjustments for 40 samples.

This calls for some boldness on the part of management. Fear has been expressed that less frequent sampling may conceal an upset beyond the time when it would otherwise be discovered, with losses so great as to overshadow the savings from sample reduction. A cursory examination of some of the records raises the question as to whether distillation tests do not have their greatest usefulness in determining the process level, while other indicators serve to reveal upsets. Apart from unusual disturbances, it appears that control is not improved by frequency of sampling. In fact, the indications are that plant operators made too many process adjustments when not in statistical control, and actually improved control by adjusting less frequently (see Figure 6). This is one of the benefits of using the moving average chart. By smoothing out the curve the frequency of adjustment is reduced.

Statistical control of laboratory testing procedures is another application of the general technique (see Figure 7). Petroleum process control is dependent upon laboratory test results, and it follows that smaller laboratory analytical errors will mean improved process control. Periodic determination of testing error is a part of good laboratory management. Education of personnel or other steps toward improvement should be undertaken as soon as these investigations reveal where problems exist. The best approach is to use statistical control charts in the laboratory. This helps bring the laboratory procedure into control and is the means of maintaining control with the minimum of effort. Complete success with plant control requires this supplementary effort in the testing laboratory.

It is important to know what to expect from quality control. Control charts are in no sense automatic in their operation. One cannot sit back and let the charts control the plant. Neither do the charts require much time and effort. The same amount of effort brings better results with statistical control than without. The statistical approach to quality control can be doubly rewarding where there was formerly neglect. Control charts are merely better tools capable of superior workmanship. Either with or without their aid, skillful operators get better results than careless operators.

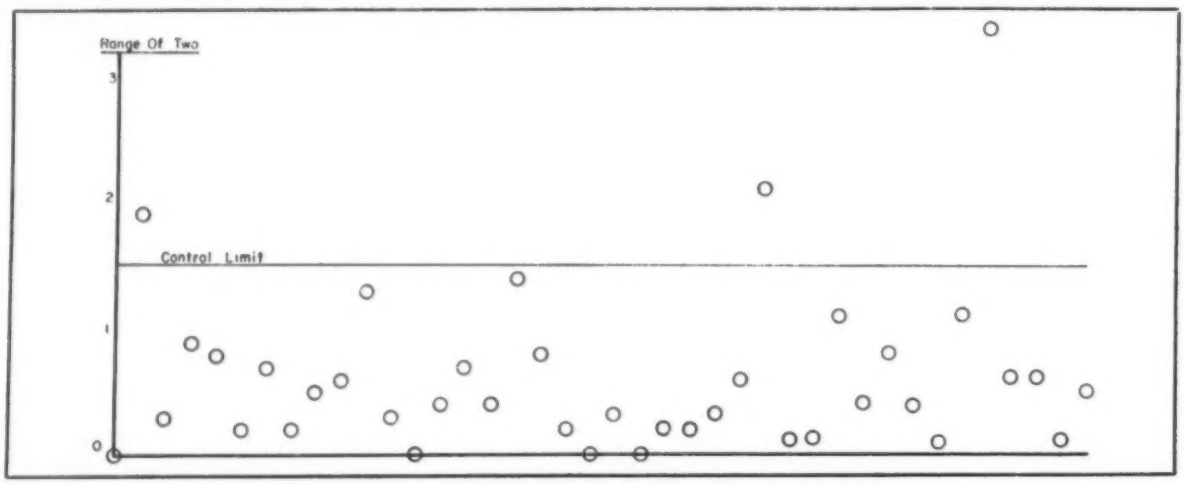


Figure 7. Laboratory control chart—range of duplicate tests on routine samples.

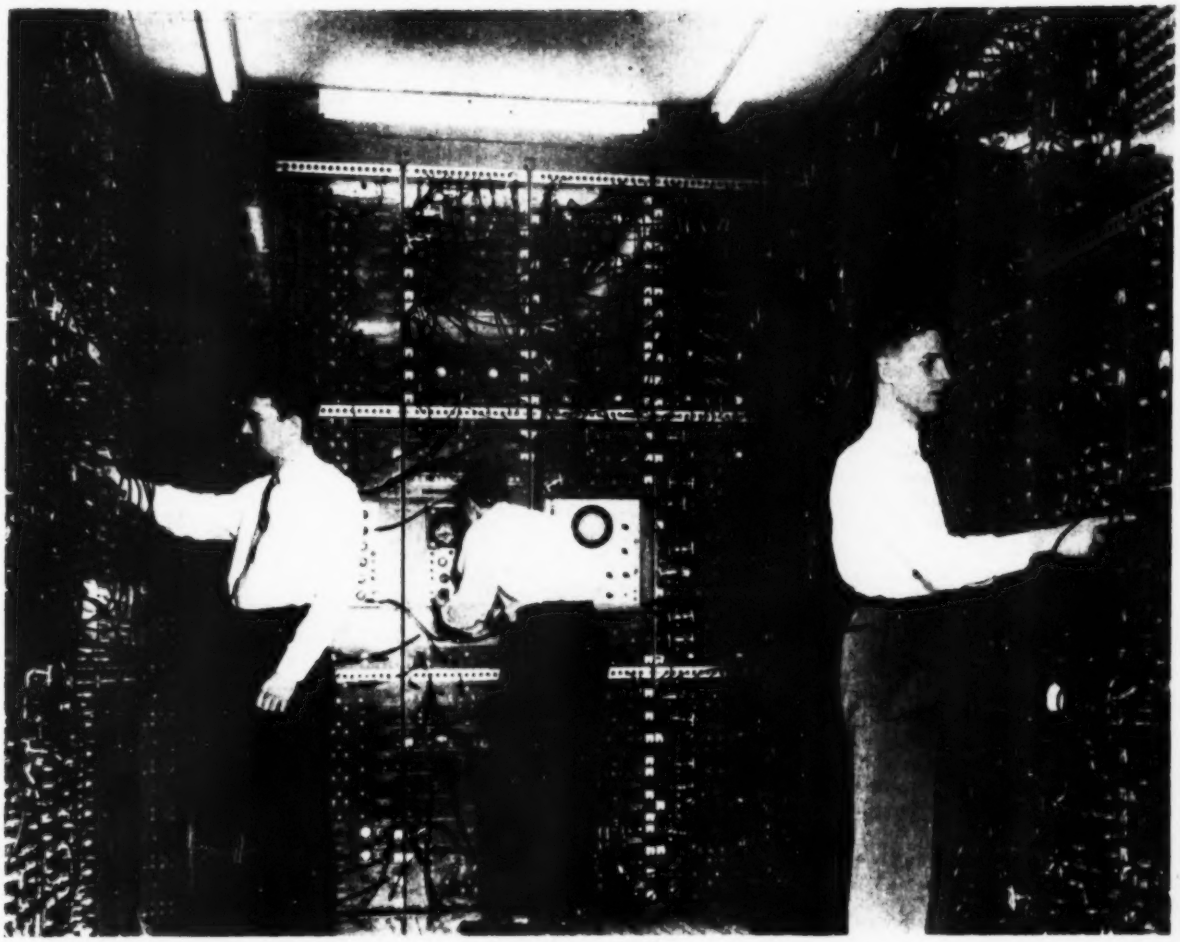


Figure 1. Automatic electronic digital computing machine.

Turn the crank and out come . . .

Pipe Stress Calculations

Automatic computers can cut calculation time to eight hours for a system involving six constraints and 100 pipe sections.

A. M. Peiser* and S. Katz,†
Hydrocarbon Research, Inc.,
New York

THE CALCULATION of expansion stresses in piping systems now is being carried out by Hydrocarbon Research, Inc., with the aid of large scale automatic computing machinery. By this means, it is now possible to perform such calculations with considerable savings of time, cost, and technical man-power.

The accepted methods of calculating expansion stresses in piping systems are based upon Castigliano's theorem relating loads and displacements at the load points. While it is generally agreed that the application of Castigliano's theorem leads to reasonably good approximations to the actual stresses and so forms a good basis for design, the complexity of the calculation and the tedious and time-consuming labor required in its execution serve to limit its usefulness either to very simple systems or to an occa-

* Present address: Private Consultant, 35 Wing Lane, Wantagh, New York.
† Present address: Consolidated Engineering Corporation, Pasadena, Calif.

sional complicated system of a critical sort.

Various simplified approximate procedures have been suggested[1] but it is recognized that these give unreliable results in many cases. If reasonably accurate stress calculations are desired, there seems to be no adequate substitute for the more rigorous procedure indicated above.

With the growing demands of high-pressure processes and the use of comparatively expensive materials in piping systems, it has become increasingly important to calculate stresses as closely as possible. It is clear however, that a balance must be struck between the requirements of good design and the burden of high calculating costs and wasted engineering man-power. With these considerations in mind, the Mathematics department of Hydrocarbon Research, Inc., has applied high-speed computing machinery to the solution of pipe stress problems of considerable generality. By this means, it has been possible to reduce time, cost, and man-power requirements, and at the same time provide reliable calculation of the appropriate stresses.

The procedure that has been developed is fully automatic and requires no specially trained personnel for its execution. The engineer need supply, directly from his drawings, only the geometrical, stress, and expansion data of the particular problem. These data are transferred by the machine operator to an appropriate input device and are fed to the machine in a specified order. The machine will then calculate internally the stresses at any specified points of the system and list the results in a form convenient for interpretation by the engineer.

The machine that we have used for this purpose is an automatic digital computer. Complete instructions are available to permit the computer to calculate stresses in piping systems involving up to six fully fixed constraints and containing any number of straight pipe sections parallel to a coordinate axis or 90° circular bends parallel to a coordinate plane. Since the great bulk of piping layouts involves only these two types of sections, we have not attempted at the present stage of the development to include skew sections. Only slight modification of the present procedure will be needed to extend the process to such cases.

The total elapsed time on the computer is quite small, even for problems of great complexity. For a system involving six constraints and one hundred pipe sections, for example, the computing time is well under eight hours. For a simple system with, say, two constaints and ten pipe sections, less than an hour of machine time is required.

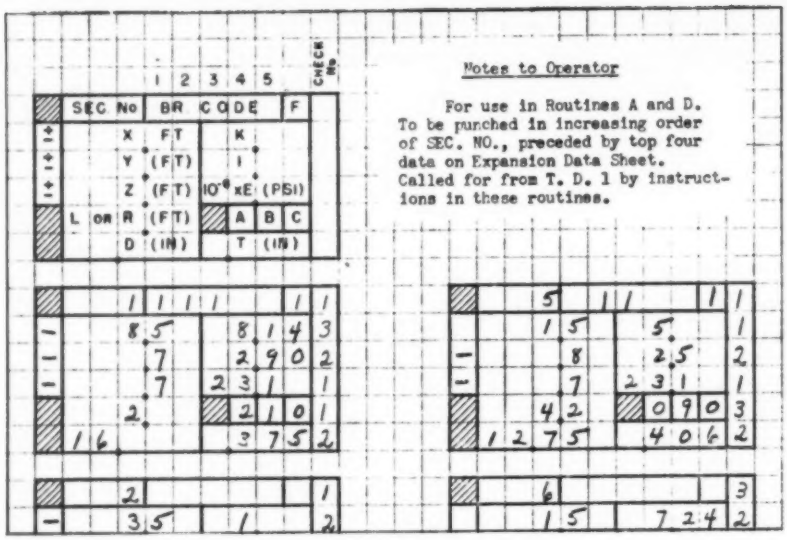

Notes to Operator
For use in Routines A and D.
To be punched in increasing order of SEC. NO., preceded by top four data on Expansion Data Sheet.
Called for from T. D. 1 by instructions in these routines.
SEC No
BR CODE
CHECK No.

Figure 2. Portion of section data sheet.

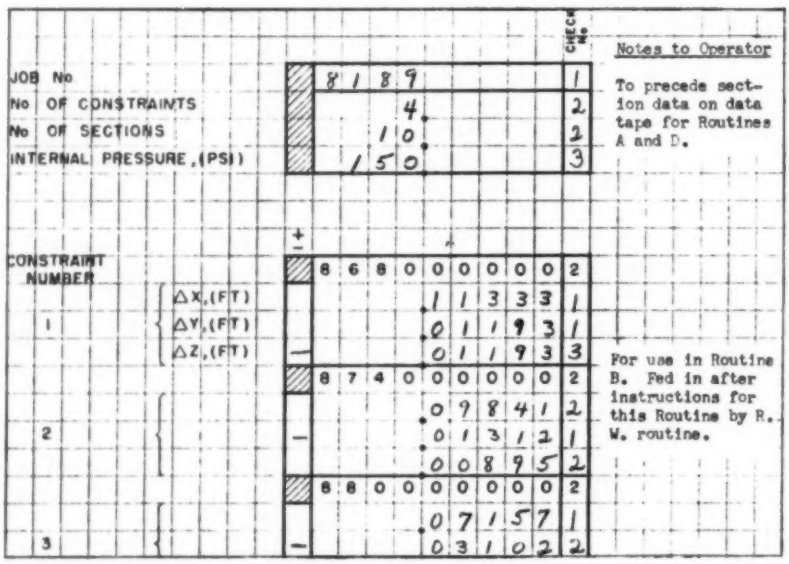

JOB No
No OF CONSTRAINTS
No OF SECTIONS
INTERNAL PRESSURE, (PSI)
CONSTRAINT NUMBER
ΔX, (FT)
ΔY, (FT)
ΔZ, (FT)
Notes to Operator
To precede section data on data tape for Routines A and D.
For use in Routine B. Fed in after instructions for this Routine by R. W. routine.
CHECK No.

Figure 3. Portion of expansion data sheet.

Preparation of Data In order to expedite the transferral of information to the machine, it is convenient to tabulate the initial data in such a manner that conversion to the machine input can be performed in a routine way by the operator. Typical data sheets currently in use at Hydrocarbon Research, Inc., are shown in Figures 2 and 3.

Data for each pipe section are entered on a "Section Data Sheet." The data required in each case include geometrical coordinates, pipe length or radius, pipe diameter and thickness, and appropriate flexibility and stress factors. In addition, certain code numbers are needed to indicate the orientation of the section and the branch of the system in which it is located.

Besides the section data sheets, one "Expansion Data Sheet" is required to supply the free expansion at each constraint, and such information as job number, operating pressure, and the total number of constraints and sections in the system. The necessary data can be transferred to the data

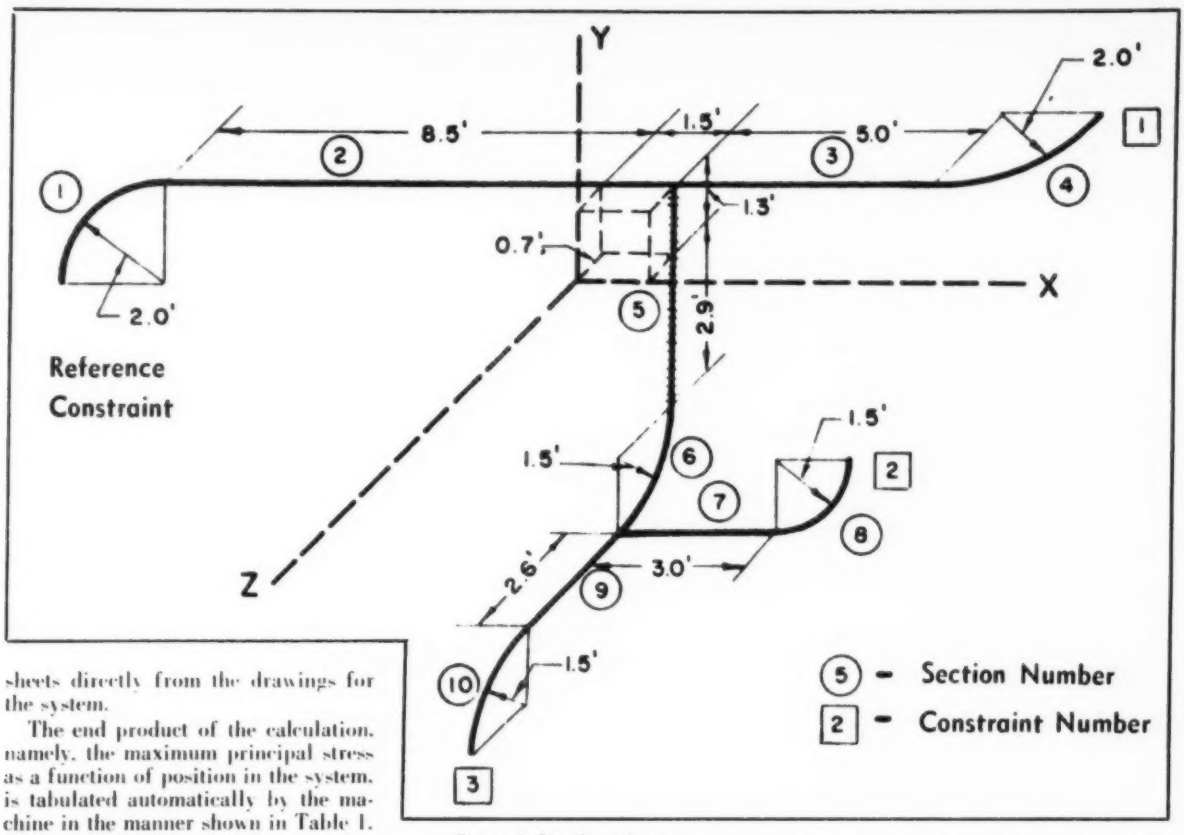


Figure 4. Sample piping system.

sheets directly from the drawings for the system.

The end product of the calculation, namely, the maximum principal stress as a function of position in the system, is tabulated automatically by the machine in the manner shown in Table 1. The maximum principal stress has been used here only as a convenience. The machine can be instructed to calculate and list any desired stresses within the system.

Example – To illustrate the manner in which the process works, there is presented here a test calculation that was used in checking the accuracy of the present formulation. The piping system used in the calculation is shown in Figure 4. This is not a real system, but rather, was created artificially in such a way that all of the various computational aspects of the process could be tested. The data sheets for typical sections, together with the expansion data, are given in Figures 2 and 3.

A partial listing of the calculated stresses is shown in Table 1. In this example, the machine has been instructed to list the stresses at the end points and midpoint of each pipe section, and at the quarter points of each straight section. One could with equal ease instruct the machine to list stresses at other specified points, or to list only those stresses which exceed a critical value. There is considerable flexibility in this matter, and the output of the machine can be adjusted without difficulty to satisfy the demands of any particular situation.

Description of Computer – A picture of the computer used is shown in Figure 1. The computer is an automatic electronic digital computing machine utilizing a magnetic drum for internal memory, and punched paper tapes for input and output. Its internal memory capacity is 300 nine-digit numbers, and it is capable of performing all arithmetical operations. Its average operating time is 0.017 seconds for addition and subtraction, and 0.050 seconds for multiplication and division. It contains convenient built-in checking features to guard against machine errors.

Judged by other automatic computers presently available, this computer may be regarded as having high memory capacity and moderate speed. In both of these respects it is admirably suited for pipe stress calculations. A considerable amount of initial and intermediate data arises during the course of a calculation, and at certain times during the process it has been found that almost the full complement of memory capacity is required to retain the necessary information. Concerning machine speed, it will be noted that the operating time is quite short, even shorter in some cases than the time required by the engineer to prepare the initial data. Because of this there seems to be no advantage in the use of extremely high speed machines in the present connection. Indeed, it appears that machines of this type provide the optimum means of performing pipe stress calculations.

TABLE 1
Listing of Final Results

Job No. 815900000 1

Sec. No.	Stress (10³-psi)	X-coordinate	Y-coordinate	Z-coordinate
001	0329.72 3	0010.50000-2	0000.70000-1	0000.70000-1
001	0026.66 3	0009.91422-2	0000.71422 2	0000.70000-1
001	0148.89 2	0008.50000-1	0001.30000 2	0 000.70000-1
002	0053.28 1	0008.50000-1	0001.30000 2	0000.70000-1
002	0042.17 2	0006.00000-2	0001.30000 2	0000.70000-1
002	0031.65 1	0003.50000-3	0001.30000 2	0000.70000-1
002	0022.65 1	0001.00000-1	0001.30000 2	0000.70000-1
002	0017.86 3	0001.50000 3	0001.30000 2	0000.700 0-1
003	0016.43 1	0001.50000 3	0001.30000 2	0000.70000-1
003	0021.04 2	0002.75000 1	0001.30000 2	0000.70000-1
003	0031.25 1	0004.00000 2	0001.30000 2	0000.70000-1
003	0043.14 3	0005.25000 3	0001.30000 2	0000.70000-1
003	0055.61 1	0006.50000 1	0001.30000 2	0000.70000-1
004	0143.77 1	0006.50000 1	0001.30000 2	0000.70000-1
004	0040.57 1	0007.91422 2	0001.30000 2	0001.28578-1
004	0309.94 1	0008.50000 2	0001.30000 2	0002.70000-2

REFERENCE

1 See, for example, S. W. Spielvogel, "Piping Stress Calculations Simplified," New York, 1943; H. Miller, "Analytical Method for Determining Flexibility of Piping," J. Appl. Mech., 1942; M. J. Fish, "Graphical Method of Making Pipe Flexibility Analysis," Heating, Piping and Air Conditioning, 1946. See, in particular, S. Crocker and A. McCutchan, "Methods of Making Piping Flexibility Analyses," Heating, Piping and Air Conditioning, 1946, where an extensive bibliography is given.

Simplified . . .

Vapor Liquid Calculations

- **Use only one column of divisions for each trial and**
- **Reduce the number of trials.**

Royes Salmon,
Placentia, Calif.

The Problem—Given the amounts and equilibrium constants of the components present; what are the amounts and compositions of the liquid and vapor phases?

The Method—Assume a value of $\frac{L}{V}$; then tabulate $K + \frac{L}{V}$ and $\frac{z}{K + \frac{L}{V}}$

Try $\frac{L}{V} = 1$:

Component	z	K	$K + \frac{L}{V}$	$\frac{z}{K + \frac{L}{V}}$
A	0.100	5	6	0.0167
B	0.200	2	3	0.0667
C	0.300	0.8	1.8	0.1667
D	0.400	0.2	1.2	0.3333
	1.000			0.5834

Now multiply the sum so found by

$$\frac{L}{V} + 1:$$

$$0.5834 \times 2 = 1.1668$$

The object is to make this last figure approach 1.000. If it is greater than one, increase $\frac{L}{V}$; if less than one, decrease $\frac{L}{V}$.

After several trials we have the final solution:

Try $\frac{L}{V} = 5.7$

Component	z	K	$K + \frac{L}{V}$	$\frac{z}{K + \frac{L}{V}}$
A	0.100	5	10.7	0.00935
B	0.200	2	7.7	0.02597
C	0.300	0.8	6.5	0.04615
D	0.400	0.2	5.9	0.06780
	1.000			0.14927

$$0.14927 \times 6.7 = 1.000$$

Composition of Liquid and Vapor—To find the moles of each component in the liquid, multiply the figures in the last column by $\frac{FL}{V}$. The vapor is obtained by difference.

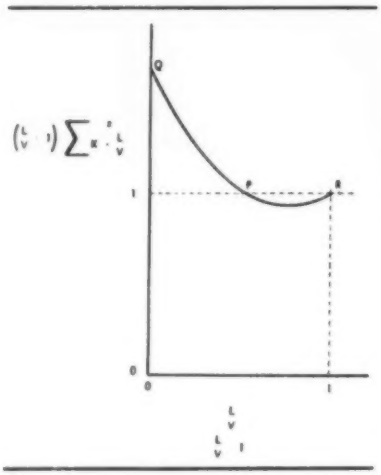


Figure 1

How to Reduce the Number of Trials: Plotting the results of each trial can greatly shorten the work, but the trick is in selecting the right variables to plot. For the vertical ordinate, use the function we are trying to make equal to one, i.e.

$$\left(\frac{L}{V} + 1\right)\sum \frac{z}{K + \frac{L}{V}}$$

For the horizontal ordinate, use

$$\frac{1}{\frac{L}{V} + 1},$$

which must be computed for each point plotted: for example, when $\frac{L}{V}$ is 5, it is 5/6 or 0.833.

Ordinary cross-ruled calculation paper serves very well for the plot. The range of the horizontal scale is from zero to one. The range of the vertical scale is theoretically from zero to infinity, but for our purposes zero to two or three is usually adequate.

Predicting the Curve

(1) The curve always has the form shown in Figure 1. It starts at some value greater than one, dips down below one, and finally comes back up exactly to one. The solution we are after is represented by the point P. The point R is a "trivial" solution.

(2) The ordinate of the starting point Q, where $\frac{L}{V} = 0$, is equal to $\sum \frac{z}{K}$.

(3) The curve always ends at the point where the vertical and horizontal are both 1.000. Its slope at this point is $\sum zK - 1$.

(4) The functions $\sum zK$ and $\sum \frac{z}{K}$ should always be evaluated at the start of the work, to make certain that the mixture is above its initial boiling point and below its dew point. In other words, both $\sum zK$ and $\sum \frac{z}{K}$ must exceed one; otherwise vapor and liquid cannot exist together.

Basis of Method—This method is based on a mathematical derivation: it is in no way empirical. The derivation is omitted from this article because it would not be interesting to most readers.

The vertical ordinate of the curve in Figure 1 represents the ratio of the calculated moles of liquid to the assumed moles of liquid. The horizontal ordinate is the ratio of assumed moles of liquid to moles of total feed.

NOMENCLATURE

F—Total moles of feed
K—Vapor-liquid equilibrium constant
L—Total moles of liquid
V—Total moles of vapor
z—Mole fraction of component in the feed

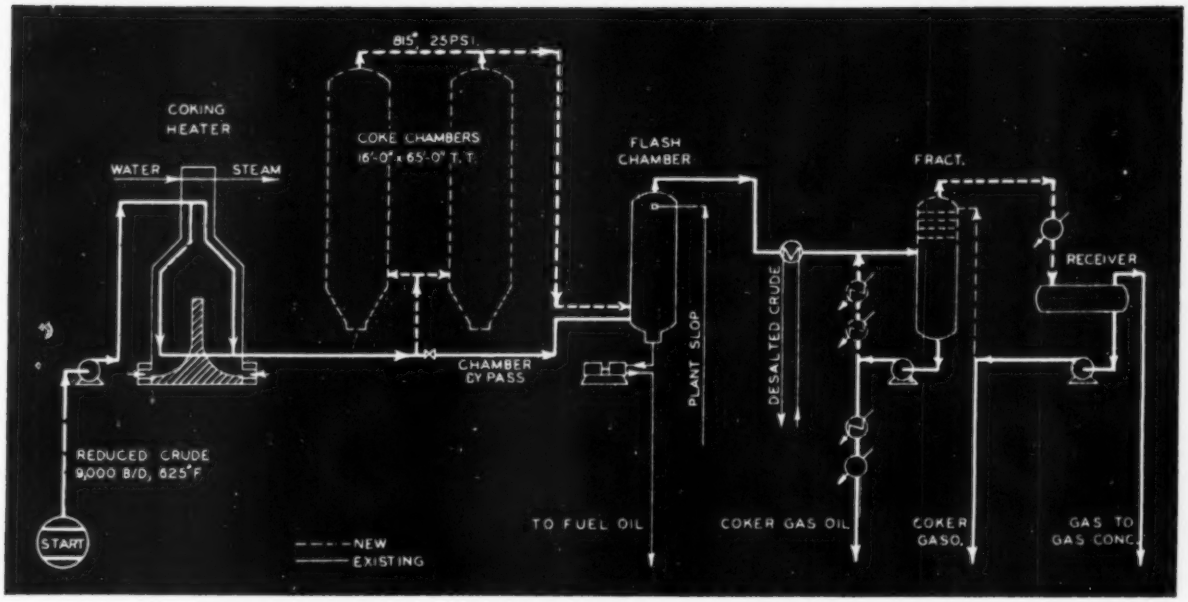


Figure 1. Process flow diagram showing coking unit integrated into existing refinery equipment.

New ideas on . . .

Chamber Coking at NCRA

Check these unique features:

- **Once through process design**
- **Maximum use of existing visbreaking equipment**
- **Gantry crane coke handling system**
- **Unusual decoking water system**

J. W. Ward and J. M. Holocek, The National Cooperative Refinery Association, McPherson, Kan.

THE INSTALLATION of a coking unit at the McPherson, Kans., refinery of The National Cooperative Refinery Association became an economic necessity with the continued decline of the heavy fuel oil market. The low pressure chamber-type unit with process design by UOP and the NCRA staff went on stream November 5 and yields maximum cat cracking charge stock with as little gasoline and coke as possible.

The unusually trouble-free operation of this unit is attributed to the once through process wherein reduced crude from the crude fractionating column is charged direct to the coking heater without recycle. Capital investment was low because processwise, the coker is essentially the former visbreaking unit with two coke chambers placed between the heater and flash chamber. Coke handling and water clarification problems were simplified by using a concrete pit spanned by a gantry crane. Coke and water fall into this pit as the chambers are decoked hydraulically.

Coking Operation—The NCRA refinery processes approximately 25,000 barrels per stream day of low sulfur 37° API Kansas crude. Cold crude is heated by exchange with crude fractionator product and closed reflux streams, then desalted in chemical type equipment[1] where practically 100 percent salt removal is achieved. Desalted crude then receives a large amount of heat from the coker flash chamber vapors and is flashed into the prefractionator where gas and light straight-run gasoline are taken overhead.

It was anticipated that the coke chamber vapors would be substantially reduced during chamber warm-up and switching periods which would upset the crude unit. Because of this, a new prefractionator reboiler circulating pump was installed to pump through an existing heater which is controlled during switching periods to compensate for the reduced coker vapors. This reboiler system was the only change made in the crude unit for the coking operation.

Preflashed crude is charged to the crude heater and into the fractionator. Straight run gasoline is removed overhead with side cuts of heavy naphtha, kerosine, distillate, diesel fuel stock and virgin gas oil for cat cracking charge stock.

As shown by the process flow diagram, Figure 1, approximately 9000

barrels per stream day of 20° API reduced crude at 625 F. is charged to the coking heater with restriction orifices and globe valves the only control for splitting into the two parallel heater streams. About 20 gallons per hour of water is injected into each charge line which helps to prevent deposition of coke before substantial vaporization can occur in the last few tubes of the heater. A steam generating coil is located in the upper convection section of the heater. The heater transfer is fed to the bottom of the coke chambers through a conventional switch valve arrangement. The overhead vapor line leads to the coker flash chamber, former visbreaker flash chamber. This vessel now serves as a possible entrainment separator and the top temperature is controlled with plant slop through a spray arrangement. A small amount of fuel oil is withdrawn as flash chamber bottoms.

The coking unit vapors continue overhead from the flash chamber through exchangers giving heat to desalted crude and then into the coker fractionator. This vessel was revamped into a fractionator at low cost from its former service as a visbreaker gas oil accumulator by extending it to allow installation of four bubble trays.

Net coker gas oil from the bottom of the fractionator is exchanged against crude, cooled and sent to cat cracker charge rundown. A new circulating stream using coker gas oil from the fractionator was installed to remove heat from the bottom of the vessel thereby reducing required tray size and reflux requirements. The circulating stream is used to preheat steam generator and desalter feed waters and is returned to the fractionator feed line. Various quench points are furnished with gas oil from the coker fractionator.

Low end point gasoline is taken overhead from the coker fractionator through condensers into the coker distillate receiver, former visbreaker distillate receiver. Using existing pumps, part of the receiver liquid is returned as reflux to the fractionator while net liquid goes to gas recovery for stabilization. Receiver gas on pressure control flows to gas recovery where 4-pound compressor suction is maintained.

This once through coking system with no recycle has given a very stable operation and there have been no flow or quality changes in the coker charge except those planned and desired and consequently no unplanned shutdowns.

All vacuum tower equipment has been kept intact and with a split coking heater transfer line, return to a visbreaking operation can be made in a minimum amount of time should conditions warrant it.

Unit Required Minimum of New Equipment—The only new process vessels added to accomplish a coking operation with the visbreaking equipment were the two coke chambers and a steam generating setup consisting of disengaging drum and mud drum. These latter two vessels would have been added even for the visbreaking operation. Other major items were the hydraulic decoking system and the coke handling equipment. Two new process pumps and three exchangers were required in the coking unit proper. One new 440-hp compressor was added to the gas recovery section to hold a minimum coke chamber pressure.

Some changes to the stabilization and poly units were necessary to accommodate the increased traffic resulting from coking and thermal cracking. Operation of the thermal cracking unit is impending since heavy cat cycle stock is no longer needed for blending visbreaker pitch to No. 6 fuel oil.

Universal Oil Products Company carried out the process design, and furnished most of the detailed flow charts, specifications and detailed heater drawings for the hydrocarbon section. The contract for mechanical design and construction of equipment within the immediate coking unit battery limits was with Refinery Engineering Company. The engineering and construction of all new and revamp off battery limits work was by NCRA personnel.

Decoking Equipment—Hydraulic decoking of the chambers is accomplished by using 1000 gpm of water at 1400 psi. A unique once through water system was developed by NCRA to fit the plant utility balance. Water is produced from wells at the 1000-gpm rate and used first through the barometric to condense the exhaust steam from the jet pump turbine. The barometric condenser is sealed in the jet pump suction tank and the well water plus condensate enters the pump at approximately 110 F. Jet pump discharge at 1400 psi is piped to the top of the structure, then down through the one piece drill stem to the cutting head. Coke and water fall through the chamber bottom head through an inclined chute into a concrete coke pit which is 250 feet long, 32⅔ feet wide and 10 feet deep. Water is withdrawn from the coke pit through a control valve to hold a constant level in the coke trap.

The coke trap is provided with a redwood slat inlet distributor, and near the outlet end has a baffle to retain floating coke fines and a weir to retain coke fines which will settle to the bottom. Water leaving the coke trap is practically free of fines and is returned to the refinery cold lime treater where residual fines are coagulated in the lime slurry and the water re-used in the plant system.

Prior to decoking a chamber, the water level in the coke pit is lowered to a minimum. Actual cutting time varies from 2 to 3 hours at 1000 gpm. During this period the water level is allowed to rise in the coke pit. Water is then withdrawn on level control at the reduced rate of 125-175 gpm for cleaning up and return to the water system over a 24-hour period. This arrangement has greatly reduced the water clarification problem which is encountered in a system where the water is returned to the high pressure jet pump or in a system where the full cutting rate must be clarified for disposal.

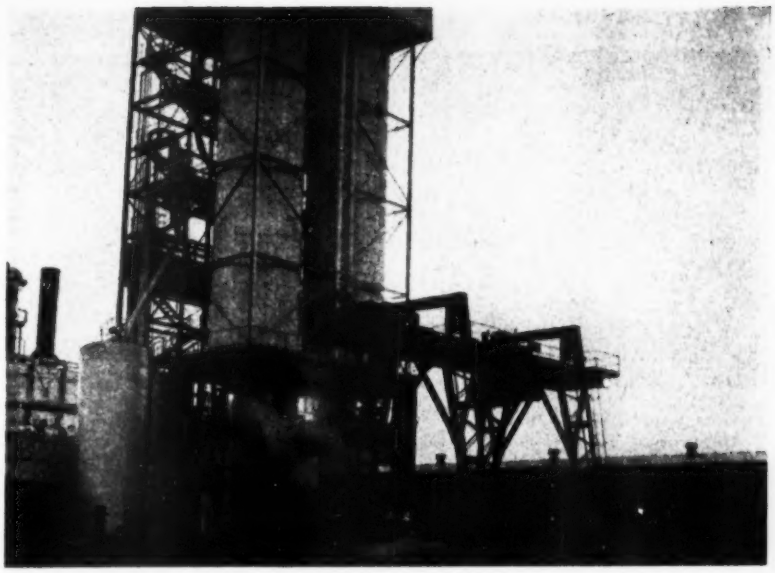
Coke Handling Equipment—NCRA borrowed their coke handling equipment idea from the power industry. At least one power plant has successfully used the gantry crane with clamshell for disposal loading of fused ash and residue which has been sluiced from boiler bottoms with water into a concrete pit. This principle was modified as necessary and has proved to be a very satisfactory method for handling a coke-water mixture.

The gantry crane selected has a capacity of three cubic yards and is provided with a double end overhang for loading into railroad cars. The crane rails are set on top of the coke pit walls and run the full length of the coke pit. Coke cut from the chambers accumulates in the pit in front of the steel coke chutes. From this pile, either above or below the water level, coke is removed by the gantry crane clamshell and is distributed along the pit or loaded directly into hopper cars which line both sides of the coke pit. The size and traveling rates of the gantry crane are such that a day's coke yield of 225 tons can be easily loaded out in six hours. The coke pit was designed so that about five days coke make can be stored if cars are not available. If more storage than this should ever be required, an area adjacent to the coke pit has been cleared where 30 days production can be piled by using the plant crane and bulldozer.

Water drainage from hopper cars which have been loaded while the coke is still quite wet is through gravel beds on either side of the railroad tracks into drainage tile which flow to dis-

posal. This water could be easily returned to the coke pit if necessary. During severe freezing weather, sufficient coke depth can be maintained inside the pit to insure adequate dewatering before loading into cars.

The gantry crane coke handling system was believed to cost less than most of the transportation systems used in the past with hydraulic decoking. It has the advantage that coke can be cut from the chambers at the maximum possible rate and is not dependent upon any other machinery to move the coke away from the bottom head of the chamber as in some methods. There is sufficient pit depth in front of the chute to hold nearly one chamber of coke without undue buildup in the chute.



Coke pit and gantry crane for handling coke.

Coking Unit Heater (Former Visbreaker Heater)—The heater was built by NCRA personnel and put in visbreaking service about a year before completion of the coker. It is a modified centerwall updraft heater that incorporates the following features which are believed to be substantial improvements.

(1) Side mounted combination oil and gas burners.

(2) Floor is brick on sand instead of suspended.

(3) Entire casing of heater is welded construction.

The radiant section of the heater was designed sufficiently wide to accommodate the sweep floor and side burners. This floor construction was used to attain the many advantages of side firing and has proved equally effective when using gas or oil fuel. It eliminates the chief objection to bottom firing of fuel oil, in that, unburned oil cannot accumulate in and on the floor. The burners in this location stay cleaner since foreign material does not fall into them as in the floor burner arrangement. There are in all 20 burners, 10 on each side with a total design heat release of 30 Mm Btu per hour.

The lining of the heater is a 1-2-3 mix of lumnite, haydite and vermiculite, is monolithic and was placed by guniting. There are no special refractory shapes in the heater except burner blocks. This type gunited lining is considerably cheaper than a suspended wall and has given very satisfactory service with no repairs necessary to date.

Sand was used as backfill material from the bottom of the foundation walls and was carried upward to the sweep floor. One layer of firebrick was placed on top the sand to form the floor.

Safety tread floor plate $^3/_{16}$ inch thick was used for the casing of the heater and was attached to the heater framework by welding. Expansion joints in the steel casing were made by splitting the sheets and attaching a small channel shape. These expansion joints were located to match the expansion joints in the gunited lining.

The coking heater is the first one of this type to be erected in the NCRA refinery; however, one heater of a similar design was built in another refinery. Both of them have given satisfactory service and it is believed that these design features save an estimated 10 percent on a heater built by conventional methods.

Refinery Yields Because of the widespread interest in coking, the overall refinery yields before and after coking are presented in Table 1. It is apparent that at present prices the coking process is most attractive. All yields shown are actual plant performances when charging mixed Kansas crudes with approximately 1 percent Conradson carbon.

TABLE 1
Over-All Refinery Yields Before and After Coking

SUMMER OPERATION-MAX. GASOLINE

	Crude Distillation with Visbreaking-Vacuum, Cat Cracking and Polymerization				Crude Distillation with Coking, Cat Cracking and Polymerization		
	API Grav.	B SD	Volume %	Weight %	B SD	Volume %	Weight %
Crude	37.0	25,000	100.0	100.0	25,000	100.0	100.0
Premium Gasoline	62.5	1,300	5.2	4.6	1,450	5.8	5.1
Regular Gasoline	64.0	10,200	40.8	35.4	11,800	47.2	41.0
U.S. Motor Gasoline	67.5	1,150	4.6	3.9	1,150	4.6	3.9
Total Gasoline		12,650	50.6		14,400	57.6	
Tractor Fuels	55.5	650	2.6	2.4	650	2.6	2.4
No. 1 R.O. & Kero.	43.7	3,350	13.4	13.0	2,750	11.0	10.7
No. 2 Burning Oil	33.5	1,925	7.7	7.9	3,300	13.2	13.5
Diesel Fuel	35.5	1,225	4.9	5.0	1,225	4.9	5.0
Butane (excess)		225	0.9	0.6	250	1.0	0.7
Propane		325	1.3	0.8	475	1.9	1.1
Total overhead		20,350	81.4		23,050	92.2	
Fuel Oil	12.0 Visbr. 17.5 Coking	4,170	16.7	19.7	875	3.5	4.0
Total salable liquid		24,520	98.1	93.3	23,925	95.7	87.4
Coke, Tons SD					225		6.2
Fuel Gas burned, Mcf/SD		2,000		1.5	4,000		2.9
Pitch burned for fuel	6.0	100	1.6	2.0			
Carbon burned at Cat Crack				2.1			2.5
Unaccounted for losses				1.1			1.0
Total			99.7	100.0		95.7	100.0

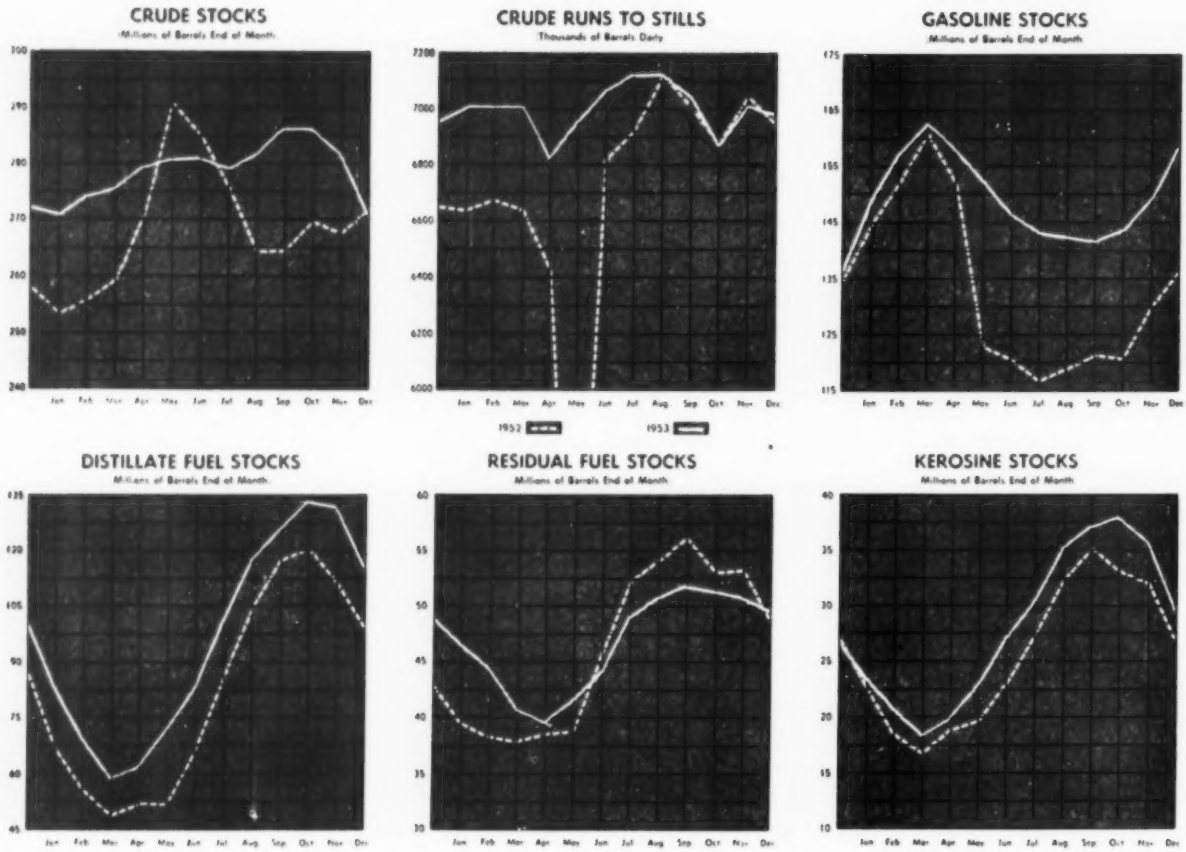
REFERENCE

[1] Kansas Refinery Completely Desalts Its Crude With Spent Caustic, O. & G. J., Aug. 16, 1953.

ACKNOWLEDGMENTS

The authors wish to express their thanks to Universal Oil Products Company and Refinery Engineering Company for review of this manuscript.

Thanks are also extended to Ralph Booker, executive vice president and general manager of The National Cooperative Refinery Association, for permission to publish this article.



Taking Stock

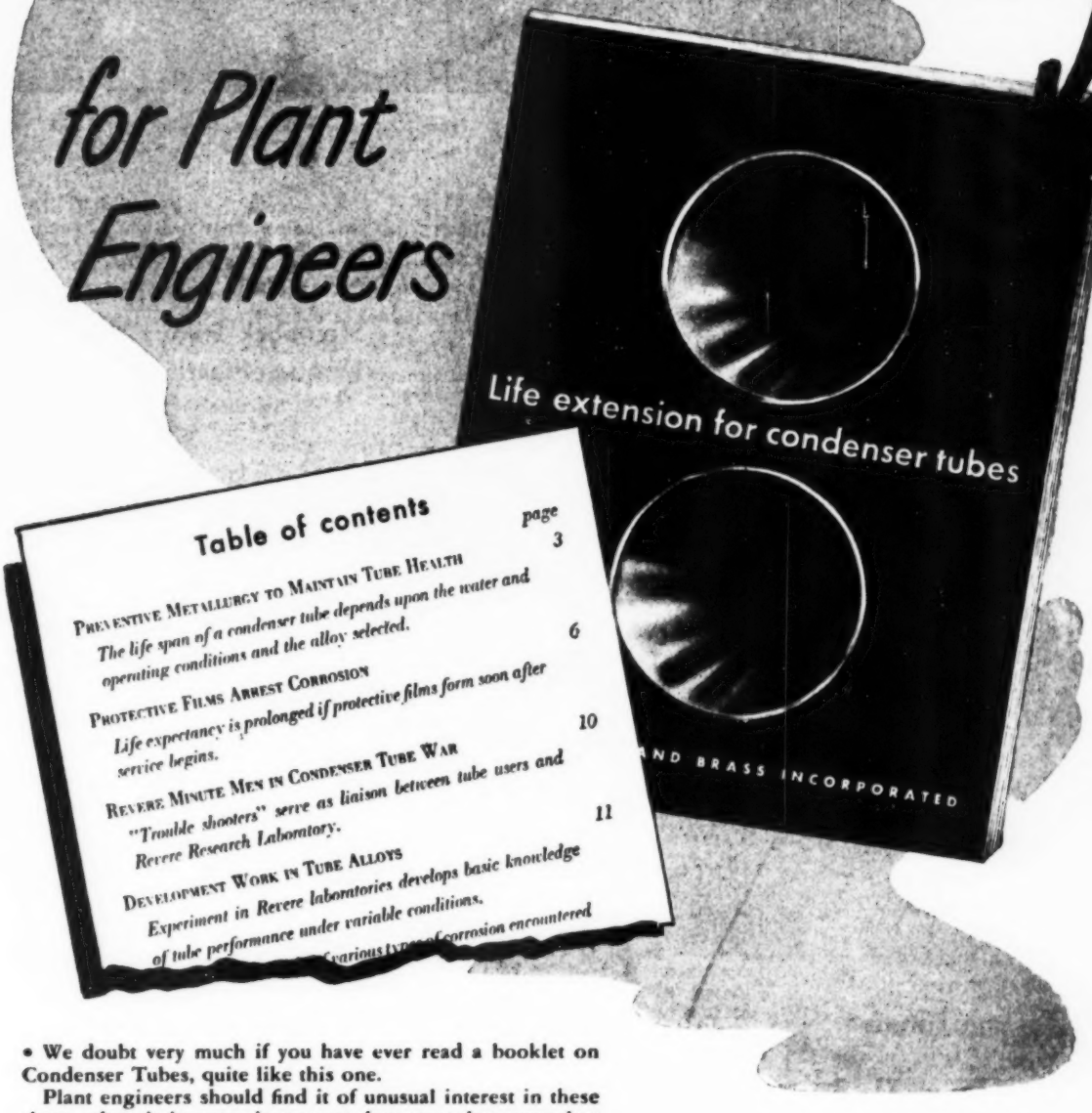
Cecil W. Smith
Economics Editor

(DATA IN THOUSANDS OF BARRELS)

MONTH	CRUDE OIL			GASOLINE		KEROSINE		DISTILLATE FUEL		RESIDUAL FUEL		DAILY IMPORTS	
	Production Daily	Runs to Stills Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Crude Oil	Total Oils
1952:													
May	5,107	4,905	290,813	2,295	123,656	229	19,614	982	51,648	979	38,821	545	951
June	6,197	6,825	285,964	3,169	120,166	317	23,061	1,455	65,911	1,228	45,888	581	901
July	6,093	6,927	275,951	3,295	116,566	358	27,387	1,475	85,775	1,237	52,245	597	892
August	6,219	7,118	264,368	3,377	118,592	375	32,401	1,514	104,257	1,252	54,061	632	879
September	6,518	7,017	264,723	3,428	120,991	350	35,021	1,502	117,252	1,230	56,200	615	932
October	6,518	6,883	269,776	3,301	120,062	352	33,289	1,458	120,721	1,203	53,052	643	1,038
November	6,487	7,049	267,852	3,416	129,509	393	32,199	1,510	116,096	1,299	53,049	624	984
December	6,634	6,952	271,928	3,361	136,028	421	26,842	1,509	99,582	1,302	48,706	603	1,165
1953:													
January	6,555	7,042	272,250	3,384	150,518	433	23,292	1,528	80,655	1,307	45,910	616	1,135
February	6,562	6,989	273,589	3,379	157,873	404	20,468	1,505	67,167	1,275	44,178	586	1,066
March	6,531	7,002	275,665	3,319	162,731	359	18,697	1,489	59,802	1,256	41,600	655	1,112
April	6,446	6,781	280,487	3,282	158,032	361	20,335	1,424	61,349	1,219	39,572	628	1,010
May	6,390	7,002	280,308	3,366	156,415	327	24,397	1,400	73,706	1,197	41,795	703	1,096
June	6,505	7,081	283,715	3,467	146,196	326	27,659	1,462	84,504	1,238	43,801	707	1,050
July	6,603	7,103	284,976	3,583	143,916	321	31,143	1,441	102,258	1,224	47,530	629	950
August	6,583	7,163	285,352	3,592	146,050	321	35,711	1,437	119,542	1,222	50,007	672	946
September	6,557	7,023	289,614	3,521	144,184	330	37,280	1,448	126,709	1,203	50,516	692	1,013
October	6,262	6,872	287,541	3,437	144,495	355	38,161	1,462	135,409	1,184	50,820	639	960
November	6,207	7,012	284,989	3,490	149,915	343	35,579	1,470	132,317	1,180	50,955	625	1,062
December	6,224	6,992	271,554	3,532	158,921	381	29,415	1,447	115,666	1,211	49,542	575	1,037
DEC. 1953-CHANGE:													
In Month	+17	−20	−10,435	+42	+9,006	+38	−6,164	−23	−16,651	+31	−1,413	−48	−25
In Year	−410	+40	−374	+171	+22,893	−40	+2,573	−62	+16,084	91	+836	−28	−128
Week Ended:													
1-23-54	6,292	7,018	271,069	3,463	167,781	393	24,034	1,509	91,401	1,185	47,247	592	1,089
1-24-54	6,492	7,031	269,623	3,308	145,879	394	23,890	1,589	85,179	1,253	46,918	538	1,003

Source: Data for last two months from API; prior monthly data from Bureau of Mines.

"MUST" Reading for Plant Engineers


Life extension for condenser tubes
Table of contents
page
PREVENTIVE METALLURGY TO MAINTAIN TUBE HEALTH
The life span of a condenser tube depends upon the water and operating conditions and the alloy selected. 3
PROTECTIVE FILMS ARREST CORROSION
Life expectancy is prolonged if protective films form soon after service begins. 6
REVERE MINUTE MEN IN CONDENSER TUBE WAR
"Trouble shooters" serve as liaison between tube users and Revere Research Laboratory. 10
DEVELOPMENT WORK IN TUBE ALLOYS
Experiment in Revere laboratories develops basic knowledge of tube performance under variable conditions. 11
various types of corrosion encountered
ND BRASS INCORPORATED

• We doubt very much if you have ever read a booklet on Condenser Tubes, quite like this one.

Plant engineers should find it of unusual interest in these times when it is more important than ever that every last ounce of use be squeezed out of the condenser tubes in their plants.

This 28-page booklet includes data on various copper alloys, photos of cut-away tube sections showing various types of corrosion encountered in condenser tube service and photomicrographs showing the grain structure of different kinds of metals under varying operating conditions.

Send for your copy today. Please make request on your firm's letterhead. Thank you. Revere Copper and Brass Incorporated, 230 Park Avenue, N. Y. 17, N. Y.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

• • •

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.— Sales Offices in Principal Cities, Distributors Everywhere

SEE "MEET THE PRESS" ON NBC TELEVISION, SUNDAY

Meet Our Authors . . .

Ward | Holecek | Prater | Jordan | Katz | Peiser | Steinbock | Sherwin | Blick

Ward and Holecek Relax With Sticks and Poles

J. W. Ward and James N. Holecek, "Chamber Coking at NCRA," page 157.

Ten years before James M. Holecek received a B.S. degree in mechanical engineering from Kansas State College in 1942, J. W. Ward was graduated from the University of Kansas. After graduation, Holecek entered the U. S. Navy, and Ward did graduate work in physical chemistry at the University of Chicago.

After studying at Chicago, Ward worked with United States Steel Corporation for a time before joining Universal Oil Products Company. As a service engineer at UOP he assisted in the start-up of some of the first wartime aviation fuel plants. He was next associated with Aurora Gasoline Company as chief engineer. In 1950 he became refinery division manager for The National Cooperative Refinery Association.

Getting out of the service after World War II, Holecek spent a short interlude with Marley Company in advertising and public relations work before joining The National Cooperative Refinery Association at the McPherson, Kan., refinery. In 1950, the year that Ward joined the association, he became plant mechanical engineer.

For relaxation, Ward gets out his golf sticks and Holecek gets out his fishing poles, and both head for the nearest spots at which they can use them. In the winter, Holecek prefers to concern himself with high fidelity audio.

Prater Designing Home for the Future

N. H. Prater, "Designing Stripping Columns," page 96.

Nilon H. Prater, who was born in Birmingham, Ala., was graduated from Georgia Institute of Technology in 1951 with a B.S. degree in chemical engineering. That same year he joined the Technical department of Magnolia Petroleum Company's Refining division at Beaumont, Texas, where he is today. His experience at Magnolia has been primarily distillation and light ends handling. He is married and has a young daughter. He lists his hobbies as designing a "home for the future" and hunting.

Jordan Introduced to Industry During Summers

John H. Jordan, Jr., "Speed Spectroscopic Analyses," page 116.

This senior chemist in the Products Control Laboratories of Magnolia Petroleum Company, received a B.S. degree in chemistry from the University of Texas in 1939. Between school terms Jordan spent his summers working as a roughneck. After graduation he roughnecked for a short time before joining Magnolia at Beaumont, doing analytical work. He is presently concerned with analytical methods applied to petroleum problems.

Jordan, whose last article for PETROLEUM **REFINER,** "Determining Tetraethyl Lead in Gasoline by Flame Photometry," appeared in August, 1953, is married and has two daughters. His hobbies are glassblowing and amateur photography.

Katz and Peiser Up On Latest Figures

Stanley Katz and Alfred M. Peiser, "Pipe Stress Calculations," page 153.

When it comes to figures (excluding Marilyn Monroe's), Stanley Katz and Alfred M. Peiser have to take a back seat to no one. Katz, who received a Ph.D. degree in mathematics from New York University in 1951, is in the Computer division of Consolidated Engineering Corporation and was formerly senior mathematician in the Process Development department of Hydrocarbon Research. Peiser, who was chief mathematician for Hydrocarbon for six years, is presently engaged in private consulting.

A New Yorker by birth Katz was graduated from College of the City of New York in 1940. Married and father of one, he was with Hydrocarbon seven years.

In his present work Peiser is concerned with the application of high-speed computers to problems of engineering design and development. In his work at Hydrocarbon he was engaged in process development studies related to the design and performance of heat transfer equipment, adsorption columns, multi-component distillation towers, etc. He has a Ph.D. degree in mathematics from Cornell University.

In addition to his consulting activities, he is associated on a part-time basis with Hofstra College, Hempstead, N. Y., as an adjunct professor of mathematics.

Steinbock Enjoys Work Through Practical Approach

S. R. Steinbock, "Simplified Method of Performance Analysis of Centrifugal Compressors," page 133.

With the neat twist of looking upon his job as his hobby, S. R. Steinbock has been extracting an extra measure of enjoyment from his work for over ten years. His simple but practical approach has served him well in England, Canada and Colombia, South America. In the oil industry he feels that there are tremendous opportunities for work which he can enjoy.

He was graduated from the University of London in 1942. Five years later he transferred to Canada, where he was associated with Imperial Oil Limited. As utilities engineer at Imperial he was concerned with a great variety of projects in steam, electric power, water and compressor installations in conjunction with the company's recent expansion program. An intercompany transfer within the Standard Oil Company (New Jersey) interest sent him to Colombia last June in connection with refinery expansion there, and since that time he has been "digging in."

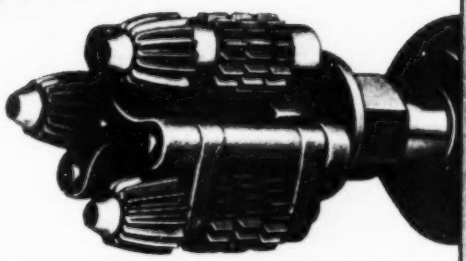
Steinbock has also found extra enjoyment in his marriage. Three years after graduation from the University of London, he was "lucky enough to find someone who enjoys classical music as much as I do, and is also fond of mountain climbing, which I rank as my foremost hobby and relaxation."

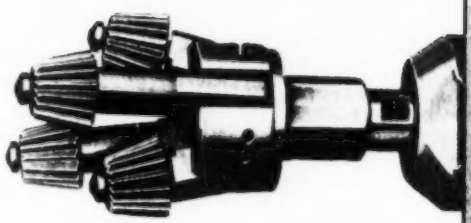
Sherwin Has Had His In's and Out's

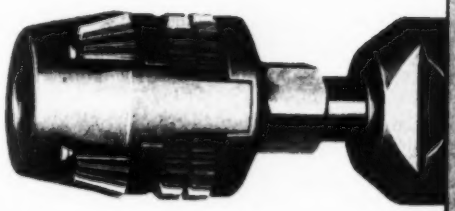
Douglas S. Sherwin, "How to Estimate Utility Costs," page 103.

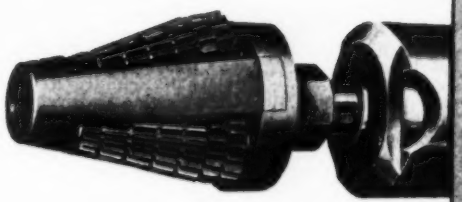
Back in February, 1942, Douglas Sherwin joined Phillips Petroleum Company, going there from Reilly Tar & Chemical Corporation, where he had been for almost two years. For a little over three years at Phillips he worked

Is your coke "different"? LAGONDA can handle it!

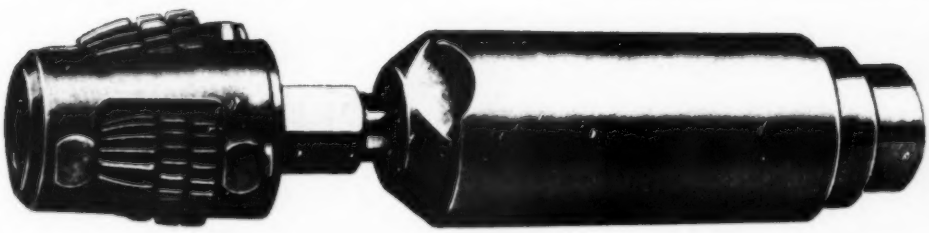








THE TYPE 3800 SERIES DUPLEX CUTTER HEAD
a double or wide expansion type.



• Some coke conditions are almost unique in their toughness. But they can be tamed and made to "say uncle" when tackled by the Lagonda brand of tube cleaning "know-how" backed up by the proper Lagonda cutter head with the hard-driving Lagonda 1100 Series motor behind it.

Your local Lagonda tube cleaning specialist regards a "different" coke condition as an inspiring challenge. Contact him—through us, if necessary—and let him do his stuff. It may save you plenty.

LAGONDA BULLETIN Y-34 gives a pretty complete story of the "how" and "why" of tube cleaning. Ask your local Elliott man, or write us direct.

ELLIOTT Company
LAGONDA DIVISION, SPRINGFIELD, OHIO

THE LONG-SURFACE SWING-FRAME HEAD with plenty of expansion for tubes of wide tolerance.

THE TYPE A-2 HEAD, particularly good on tough, uneven coke deposits.

THE TYPE B9 HEAD, widely used for its adaptability to average coke conditions.

THE TYPE ONE HEAD, designed especially and solely for the heavily heavy coke.

THE FAMOUS 1100 SERIES MOTOR, whose exceptional power reserve, dependable operating design and consistent performance is common to all Lagonda blowpipes.

IF IT'S TUBE CLEANING...IT'S LAGONDA

Y3-11

Salmon Murphy Sanders Preston Smith Dinneen Walter Fletcher Browning

on the process design and process engineering for the Phillips-operated government-owned butadiene plant. From November, 1945, to August, 1947, he was assigned to Bartlesville, Okla., by Phillips to work in process design and process engineering.

It was at this point in his career that Sherwin began to have his in's and out's. In August, 1947, he began a leave of absence on which he first attended the University of Oxford, next joined the Office of Military Government (U. S.) and High Commission for Germany at Berlin, and then returned to Oxford to receive a B.S. degree with honors. After returning to the U. S. and serving one year with Phillips Chemical Company's Engineering Economic Analysis Group, he was put on loan service to the Reconstruction Finance Corporation. He has been there since and, as he puts it, his loan service is "supposed" to end next August.

A graduate of Pennsylvania State College, Sherwin has had several articles published.

Blick Adds No. 6 to List of Contributions

Robert G. Blick, "A New Technique for Pipe Flexibility Calculations," page 123.

With this paper, Robert G. Blick has brought his contributions to PETROLEUM REFINER to six, his first one having appeared in December, 1949. Outside of "Analytical Solution for Crowded Ends of McCabe-Thiele Diagram" in August, 1952, his articles have been on stress analysis subjects. He has presented two talks for the ASME, one an annual conference paper in 1951 at Tulsa.

His education has been through evening extensions, some at the University of Manila while with the Armed Forces in World War II, and study on his own. He has worked in the engineering fields of electronics, vibrations, structures, mechanics, aeronautics and chemistry. He is at present with the Process staff of Brown and Root, Inc., Petroleum and Chemical division. Blick's chief hobbies are acoustics and music appreciation.

Eldridge Well Versed In Management Problems

William C. Eldridge, "Shortage of Managerial Talent Critical, Part I," page 248.

An alumnus of Dartmouth College and the Amos Tuck School of Business and Finance, William C. Eldridge spent his first ten years after college in marketing and merchandising work for Montgomery Ward, Crane Company and Radio Corporation of America.

Since joining the management consulting firm of Booz, Allen and Hamilton in 1944 as a staff engineer, he has served successively as account supervisor, manager of the firm's Service Research department and as resident executive in charge of the firm's Los Angeles office. He now holds the last position.

Meet Our Authors...

Salmon Would Exchange Mathematic Puzzles

Royes Salmon, "Simplified Vapor Liquid Calculations," page 156.

Anyone have any mathematical puzzles? Royes Salmon, senior engineer in Union Oil Company of California's Process Engineering group, works them as a hobby and would be "delighted" to exchange some with readers of PETROLEUM REFINER. Other hobbies which he enjoys are chess, a home workshop and "a fairly bad game of tennis."

Born in Brooklyn, Salmon received a B.S. degree in chemical engineering at Cooper Union Institute of Technology. He joined Union Oil Company in 1948.

Aikman Offers Aid on Computing Income Tax

A. E. Aikman, "Are You Paying Too Much Income Tax?," page 92.

An attorney with Magnolia Petroleum Company at Dallas, A. E. Aikman received a B.S. degree in economics at Texas A. & M., an LL.B. degree at Southern Methodist University. From 1950 to 1951 he held the Southwestern Legal Foundation fellowship for study in taxation at S.M.U. He is a member of the Texas Bar and is admitted to practice before the Treasury Department and the Tax Court.

Murphy Gets Facts From Original Source

Louis J. Murphy, "Use These Charts to Simplify Refinery Calculations," page 145.

Long a student of refinery and petrochemical plant design, construction, and operation, Louis J. Murphy is the author of several articles on various phases of this subject. His most recent for this publication was "How to Engineer Refinery Compressed-Air Systems," which appeared in the December, 1952, issue. As design engineer and operations supervisor with several different oil companies, he has been able to observe firsthand the subjects about which he writes.

Five years ago Murphy and a partner set up a consulting firm. Since then he has really warmed to his subject, making studies of all sizes of refinery and petrochemical plants.

A boating enthusiast in the summer, Murphy relaxes in the winter by "helping" his son in the construction of model railroads.

Sanders Roots For Texas A&M From Beaumont

R. G. Sanders, Jr., "Quick and Easy Temperature Measurements with This Portable Thermowell," page 140.

In January of this year, R. G. Sanders was graduated from Texas A. & M. College with a B.S. degree in chemical engineering. One month later he joined Magnolia Petroleum Company's Beaumont, Texas, refinery. He previously had worked several summers with Magnolia. His spare time is taken up by hunting, fishing, boat operation, machine shop work, and his activities in AIChE and the Beaumont Texas A. & M. Club.

Preston and Smith Join On Analysis Article

S. T. Preston, Jr., and Dan E. Smith, "Natural Gasoline Analysis," page 137.

Until recently, when he became assistant to the president of Podbielniak, Inc., of Chicago, S. T. Preston was an instructor of the Natural Gasoline Association of America's Low Temperature Fractional Analysis School. Sandwiched between his first degree, a B.S. in chemical engineering from Virginia Polytechnic Institute, and his second, an M.S. in chemical engineering from the University of Michigan, was a three-year hitch in the Signal Corps. With these two degrees he joined the Oil Field Research division (Natural Gasoline Group) of California Research Corporation but within three and one-half years he was back in school, this time working towards a Ph.D. degree at the University of Texas. At Texas he became assistant professor of petroleum engineering, his first teaching assignment. His next one was at the NGAA school.

Dan E. Smith has been with Phillips Petroleum Company as an analytical chemist since 1937, the year he was graduated from Drury College, Springfield, Mo., with a B.S. degree in chemistry. Smith, named assistant manager of the Analytical section of Phillips' Research division in 1945, has had many

* See AUTHORS, Page 194

How to Assure Low-Cost Steel Valve Service ...in Hot Oil Handling, for example

THE INSTALLATION

In the world's largest natural gasoline and gas cycling plant at Katy, Texas, with Crane steel gate valves on absorption oil heater lines. Working pressure, 160 psi, 520 deg. F.

VALVE SERVICE RATINGS

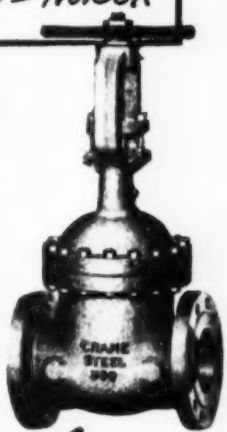
SUITABILITY:	Fully effective
FEATURES:	Crane Exelloy Trim
MAINTENANCE COST:	Nil – routine care only
SERVICE LIFE:	10 yr. plus – prolonged life assured
OPERATING RESULT:	No shutdowns for valve trouble
AVAILABILITY:	Crane Catalog item – No. 33X

THE CASE HISTORY

Installed as original equipment, these Crane No. 33X 10-inch gate valves have given continuous service since 1943. Year after year, they remain fully effective under severe conditions. They seat tightly with smooth, positive operation, yet with no maintenance other than periodic cleanout of accumulated oil sludge. Their Crane Exelloy seating surfaces show no sign of corrosive or erosive effects. They assure the plant of continued trouble-free, low-cost performance.

Obviously, valves that behave like this aren't bought on price alone. Quality is the first consideration. That's thrifty buying—the only way to get the best value.

THE VALVE



It stands apart from ordinary performance because of pioneering skill in steel casting . . . leadership in design and manufacture . . . and complete suitability for petroleum industries' process and power service needs. Choose from the widest range of body and trim materials, in all pressure classes and sizes, with flanged, screwed, or welding ends. See your Crane Catalog or Crane Representative.

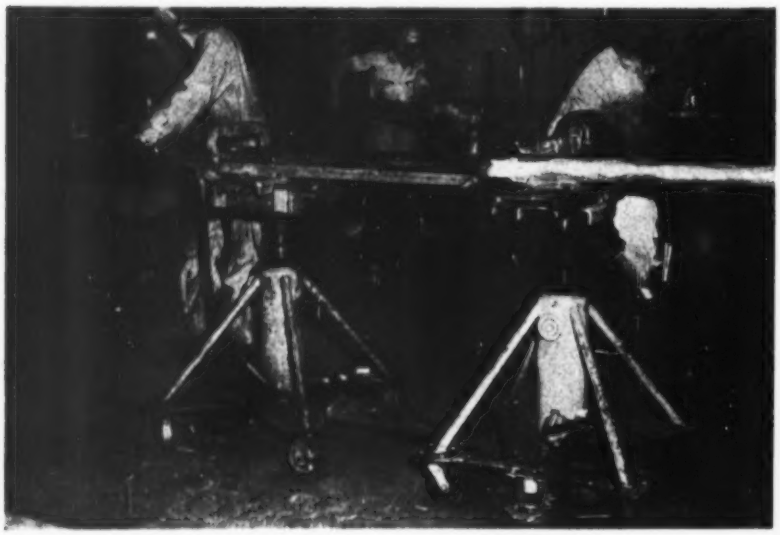
THE BETTER QUALITY...BIGGER VALUE LINE...IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

How to Do It . . .



Jigs Aid Mass Production

The welding jigs shown in the above illustration have one unusual feature—once the necessary appurtenances are set, repetitive type welding can be accomplished with great speed and facility.

Standard hydraulic lift jacks are used to support the unusual jig assembly. The assemblies are constructed by bending to the desired rectangular shape sections of sheet metal that are approximately 18 x 12 x ¼-inch. Sheet metal slots used as guides for the pipe are attached to the jig platform with removable bolts.

This is how the assembly is operated. The length of pipe or tubing is fixed on the edge of the jig nearest you in the picture. The jigs are leveled and the exact positions established for the tubing. Then clamps are applied. Next, additional lengths of tubing are fitted onto the jig in the adjacent slots. They will automatically be leveled as is the first piece of tubing. Then clamps are put into place to secure the tubing.

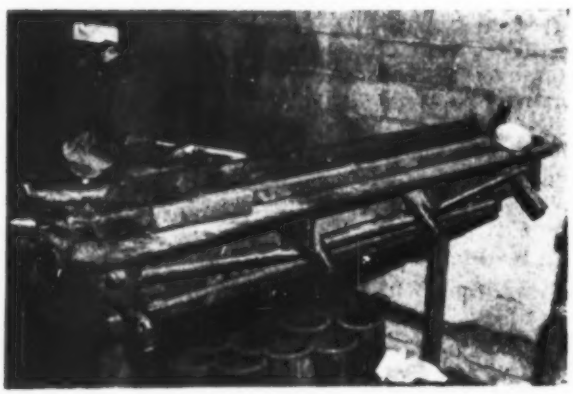
Table-Mounted Flange Speeds Valve Handling

The table-mounted flange shown in the illustration greatly improved valve maintenance at one large refinery. The shop-built gadget is easily constructed of scrap materials.

A discarded flange is mounted to a threaded coupling which has been slit lengthwise. To the coupling are welded two ears which are in turn perforated; a bolt is then inserted through the perforations. This construction permits rotation of the flange connector within the coupling so that the flange can be fixed in any position throughout an arc of 360 degrees. In addition, the flange is bored with many different sized holes placed on several different spacings to accommodate the full range of sizes of valves which enter the shop.

As shown in the picture, the valves to be repaired are moved in place with the assistance of an overhead hoist. Generally, two bolts are sufficient to attach the valve rigidly to the flange. Notice also that the air supply used in cleaning the valves is stored on a pay out reel for convenience. The table supporting the flange provides ample work area and storage space for other tools.

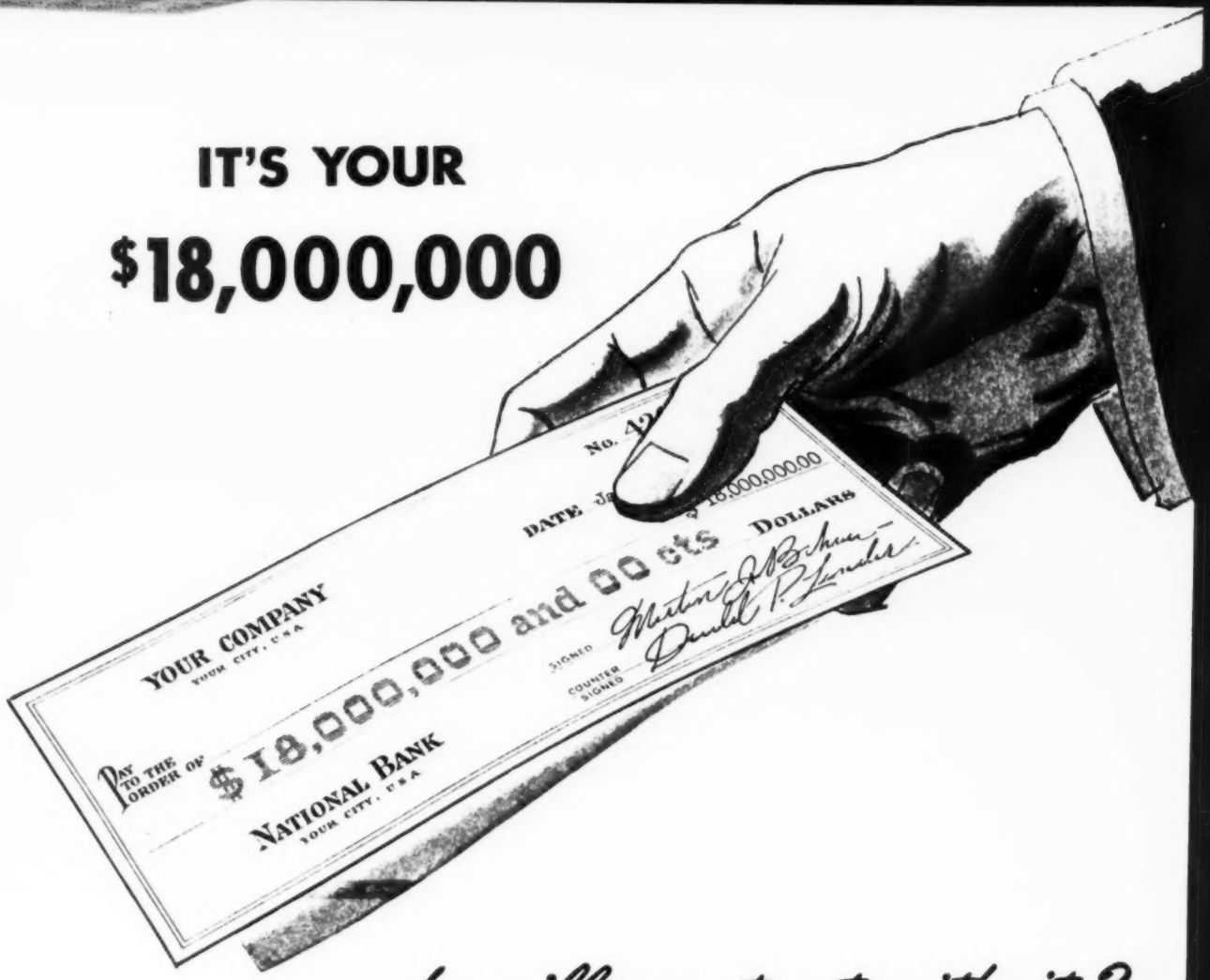
Shop Scraps Make Sheet Metal Bender



Most maintenance shops must have some type of equipment that can be used to bend and shape sheet metal. The equipment shown is not unusual in design, but it shows what can be done with scrap metal.

Most of the scrap used in the construction is ½-inch and ¼-inch thick steel plate. The four sleeves are made of sections of 1½-inch pipe. When the sheet metal is placed in the bender, lengths of pipe are inserted in these sleeves so that the necessary leverage to bend the sheet metal can be obtained. The ¼-inch thick plate to which these sleeves are welded is pivoted at each end by welding ¾-inch rod to each end of the plate, and then fitting these rods into holes in an anchor block of ⅜-inch thick plate.

IT'S YOUR $18,000,000



... who will you trust with it?

WHEN your company invests that kind of money in new plant construction you will have to have confidence—a lot of confidence—in the people you trust with the job.

You can find plenty of evidence of complete confidence in McKee among some of the world's largest corporations in the industries we serve. Most of the big names in these industries have called on us again and again for McKee design, engineering and construction services . . . the type of sound thorough efficient services you want for *your* money.

McKee Engineering Services

Arthur G. McKee & Company • Engineers and Contractors

Headquarters: McKee Building • 2300 Chester Avenue • Cleveland 1, Ohio
Offices: New York • Tulsa, Oklahoma • Union, N. J. • Washington, D. C.
British Representatives of Metals Division: Head, Wrightson & Co., Limited
Canada: Arthur G. McKee & Company of Canada, Ltd., 350 Bay St., Toronto

THIS NEW AUTHORITATIVE GUIDE TO PIPING MOTION CONTROL SHOULD BE AN IMPORTANT PART OF YOUR BASIC ENGINEERING FILE

The New FLEXON Expansion Joint Design Guide

THE FLEXON EXPANSION JOINT LINE-UP

Flexonics Corporation manufactures a complete line of corrugated type stainless steel and copper expansion joints in Free-Flexing (low pressure), Controlled-Flexing (high pressure) and Flexoniflex (extremely high pressure) units. Sizes range from ½" to 48". Units are available for temperatures from —400° F., to 1600° F., and for pressures from vacuum to 5500 psi. Write for further information or see the Flexonics catalogs in Sweet's Plant Engineering File, Chemical Engineering Catalog or The Refinery Catalog.

Now at last, comprehensive, up-to-date information on the absorption of motion in piping has been gathered together in one easy-to-use booklet. In its new Expansion Joint Design Guide, Flexonics Corporation offers an authoritative handbook of piping design and layout! Included in the booklet are thorough discussions of types of motion, design considerations pertaining to the physical characteristics of expansion joints and anchoring and guiding, typical piping layouts, computation of thermal expansion, safety factors and many other vitally important factors in piping design.

Much of the information presented is available nowhere else; all of it helpful to anyone responsible for the design, installation or maintenance of piping. Copies of the Flexon Expansion Joint Design Guide are available without charge. Write for your copy, today.

Flexonics Corporation

EXPANSION JOINT DIVISION
1336 S. THIRD AVENUE • MAYWOOD, ILLINOIS

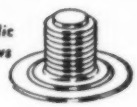
FORMERLY CHICAGO METAL HOSE CORPORATION
In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario

Flexon identifies products of Flexonics Corporation that have served industry for over 30 years.

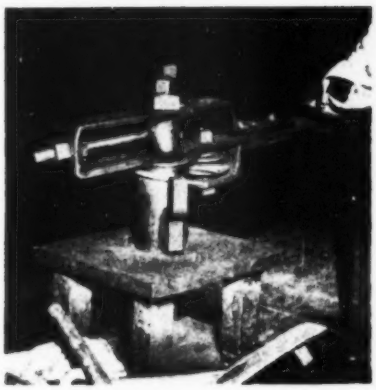
Flexible metal hose

Expansion joints

Aircraft components


Metallic bellows

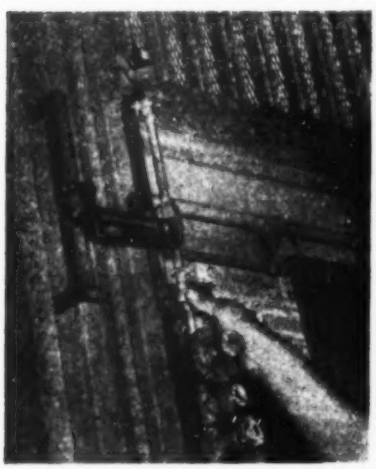
How to Do It...



Jig Enables Operator to Increase U-Bolt Output

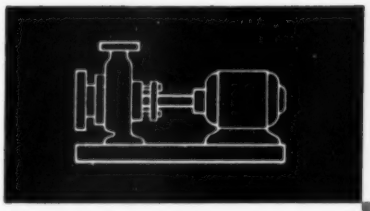
The jig shown in the above photograph bends steel rods into u-bolts in a fraction of a minute. An experienced operator can produce u-bolts at the rate of perhaps 20 per minute.

Simply constructed, the jig can be built in any shop. Start with a foundation of 2-inch bar steel for legs, supporting a ½-inch steel plate, mount the jig thereto. Attach a lever arm to a center pinion to allow plenty of leverage for the operator. The u-bolts are held in place with a steel bracket. The end of the bar that receives the force from the lever can be made by running a bolt through a common pulley.



Prisms Aid Reading of Overhead Mercury Column

The prism in the above photograph greatly facilitates high level mercury column readings. The mercury column shown is standard equipment in most



What do pump manufacturers and pump users say about Sealol-Flexibox Mechanical Shaft Seals? Do these shaft seals stand up? Do they prevent leakage under rigorous conditions? Are they safe? Let these typical cases speak for Sealol-Flexibox . . .

LET'S GET DOWN TO CASES...

MAY 4, 1953

Leading pump manufacturer orders eleven Sealol-Flexibox Seals for following applications: Butane and lighter fractions at 580 psig.; liquified petroleum gases at 190 psig.; ethylene and ethane at 480 psig.; rich oil at 560 psig.; liquified petroleum gases at 150 psig.; caustic solution at 585 psig.

NOV. 3, 1953

Major oil refinery "enthusiastic" over performance of Sealol-Flexibox Seal on butane pump (1¾"shaft) at pressures to 400 psig.

MAY 16, 1953

World famous petroleum processing and refining organization standardizes on Sealol-Flexibox Mechanical Shaft Seals for new and existing pumps.

FEB. 11, 1953

Refinery so satisfied with performance of Sealol-Flexibox Seal on propane pump operating at 263 psig. they are now substituting Sealol-Flexibox Seals for those presently fitted on other pumps.

JUNE 9, 1953

Oil refinery reports very satisfactory performance of Sealol-Flexibox Seals handling propane at pressures as high as 420 psig. suction pressure — and 555 psig. delivery pressure.

APRIL 10, 1953

Refinery reports highly satisfactory performance of approximately 60 Sealol-Flexibox Seals in continuous operation since the summer of 1951, handling a large variety of fluids, including Dowtherm at 425°F.

SEALOL

Sealol Corporation, 13 Willard Ave., Providence 5, R. I. Chicago, Cleveland, Los Angeles, Houston, Philadelphia, Kansas City, Charleston, W. Va.

THE BALANCED PRESSURE SEAL

ENTIRELY NEW!

Explosion-Proof! Dust-Tight! Rain-Tight!

CIRCUIT BREAKER, MOTOR STARTER and COMBINATION MOTOR STARTER

UNILETS

REG. U.S. PAT. OFF.

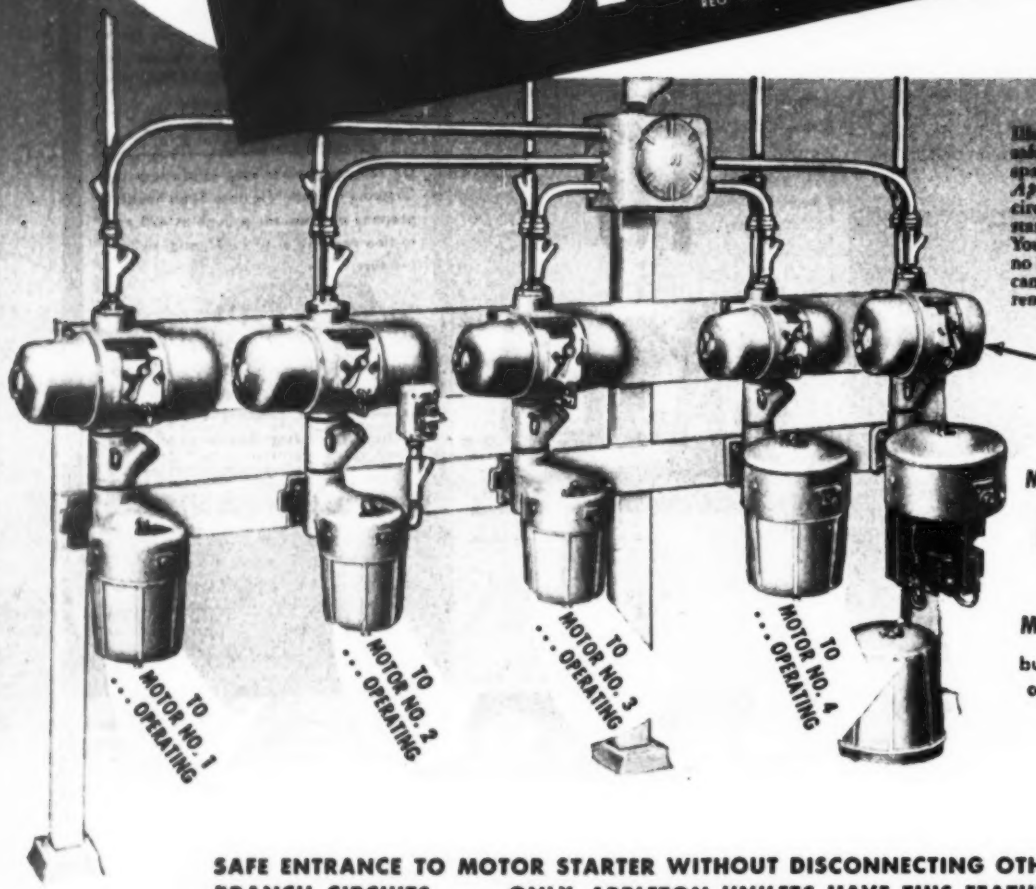


Illustration shows the high safety factor, versatility, and space-saving attributes of *Appleton* explosion-proof circuit breaker and motor starter *Unilet* Combinations. Your own installation needs, no matter what they may be, can also be met with these remarkable new Unilets.

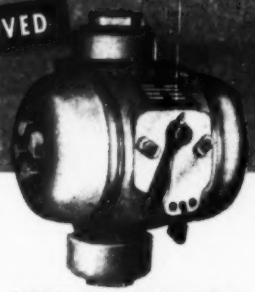
BREAKER LOCKED IN "OFF" POSITION

MOTOR STARTER NO. 5 . . . EXPOSED FOR SAFE MAINTENANCE . . .

but no "down time" on other operating equipment

SAFE ENTRANCE TO MOTOR STARTER WITHOUT DISCONNECTING OTHER BRANCH CIRCUITS . . . ONLY *APPLETON UNILETS* HAVE THIS FEATURE!

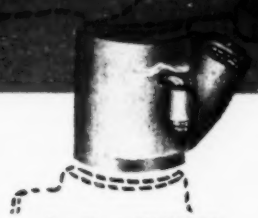
U. L. APPROVED



"CB" Circuit Breaker UNILETS

Assure easy, safe, flexible, and economical installation for protection of service entrance, feeder or lighting, appliance, and branch circuit conductors up to 225 amperes. U. L. Approved individually and in banked groups up to three for forms 1 and 2 without using dividing seal.

U. L. APPROVED



Sealing UNILETS

Available for use as explosion-proof seal where needed on circuit breaker and motor starter Unilets. This Sealing Unilet is furnished on all Combination Motor Starters, and when properly sealed permits safe entrance to a motor starter in single or banked combination installations, without disconnecting other branch circuits.

U. L. APPROVED

"LS" Motor Starter UNILETS

For 3-phase induction motor control up to 100 H.P. at 600 volts maximum. Lightweight construction of larger sizes eliminates need for heavy lift equipment . . . assures easy, time-saving, inexpensive installation. Also made for reversing and two-speed motors.

The greatest advance in explosion-proof design in years!

● You expect more from *Appleton*, and you get it! The proof lies in these completely new and different *Appleton* circuit breaker and motor starter *Unilets*. Alone or in combination, their design, construction, and performance give you maximum safety, unparalleled ease of wiring, installation and maintenance, and initial and long-term money savings not available with any other equipment! You'll find their exclusive features invaluable on any hazardous-location motor control or power lead-in installation, large or small, indoors or outdoors, where tricky wiring, corrosive and flammable atmospheres, dust, or weather difficulties appear insurmountable. Where absolute safety is required day in and day out and every minute of the day, you can place complete confidence in *Appleton Unilets*.

IMPORTANT ADVANTAGES

FIRST to be U. L. Approved for BANKED Circuit Breaker Grouping

Combinations Meet U. L. Requirements through Approval of Components

FIRST to Achieve Safe Entrance to Motor Starter of a Combination without Shutting Off Other Branch Circuits

Full 7-Thread Explosion-Proof Protection . . . No Bolts to Strip or Flanges to Nick

Unmatched Accessability for Easiest Wiring and Servicing on Every Job

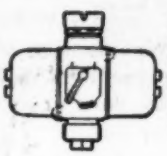
Light-Weight Construction for Easy Installation without Heavy Lift Equipment

Quick Interchange on All Leading Makes of Circuit Breakers and Motor Starters

Flexible Field Set-ups Assured with Single and Duplex Male and Female Hub Adapters

BANKED CIRCUIT BREAKER GROUPING

Male to female hubs permit easy grouping. Cuts costs, streamlines panel set-ups, assures coordinated control without sacrificing safety. U. L. Approved up to groups of three in smaller size Unilets.



OVER-SIZE CONDUIT and CONDUCTORS

May be run with hub adapters for subsequent installation of higher rated breakers without replacing complete Unilet or existing conduit.

VERTICAL "STRAIGHT-THRU" DESIGN

Simplifies wire pulling, saves time. Ample working space eliminates need to remove breaker mechanism from enclosure, yet assures clean, safe wiring.

Patent Applied For

PUSH-BUTTON and PILOT DUTY CONTROL

Combines convenience and selectivity including built-in "Start-Stop," "Hand-Off-Auto.", or "Jog-Run-Off" control where needed.

Sold Nationally Through Electrical Wholesalers

APPLETON ELECTRIC COMPANY

1732 Wellington Avenue, Chicago 13, Illinois

APPLETON ELECTRIC PRODUCTS

Also Manufacturers of:

Explosion-Proof Fixtures

Industrial Lighting

"ST" Liquid-Tight Connectors

Automatic Reelites

Outlet Boxes, Covers, Switch Boxes

WRITE TODAY FOR

BULLETIN BH

A complete catalog section containing informative technical data.

Rely on APPLETON . . . *The Standard for Better Wiring*

DOES THERMO ELECTRIC MAKE WIRE TYPE THERMOCOUPLES?

CERTAINLY. TRY AND NAME A THERMOCOUPLE T-E DOESN'T MAKE.

WIRE TYPE, PROTECTED THERMOCOUPLE

In Iron Constantan, Copper Constantan, or Chromel Alumel; mirror-polished protection tube resists chemical corrosion; for temperatures from as low as −300° F up to 2400° F, depending on calibration.

The wire type is one of many, standard, T-E thermocouples for taking process temperatures. Other kinds include tubular, bayonet immersion contact, exposed loop, and shielded.

Each careful step in their production, from calibrating to final testing, is handled in T-E's own plant. Our production facilities, combined with the skill and experience of our engineers, are at your service to develop special 'couples for unusual applications.

Furthermore, at T-E you can choose from a large selection of protection tubes — built-up or bar stock — in stainless steels and a wide range of other materials. Will we make special tubes? Of course.

Interested? Want the name of the T-E rep nearest you? Let us know, on your letterhead. Want more data? Ask for Catalog 22-X.

Pyrometers • Thermocouples • Protection Tubes • Quick-Coupling Connectors
Thermocouple and Extension Wires • Resistance Bulbs • Connector Panels

Thermo Electric Co., Inc.

SADDLE RIVER TOWNSHIP, ROCHELLE PARK POST OFFICE, NEW JERSEY
IN CANADA—THERMO ELECTRIC (Canada) Ltd., BRAMPTON, ONTARIO

How to Do It . . .

instrument testing laboratories and will vary in height from 20 to 40 feet. Some operators utilize ladders to facilitate the high level mercury readings.

One refiner has greatly improved on the system by installing a triangular-shaped prism arrangement which makes it possible for the operator to remain on the ground level of the testing room. Two prisms are arranged at two different levels on the mercury column. A mirrow effect is achieved wherein the upper prism reflects the mercury level to the lower prism which is discernible to the tester.

The prisms are held in place with thumbscrews with the upper prism on a pulley arrangement, which facilitates the raising and lowering.

2-Inch Pipe Makes Legs For Orifice Meter Chart

Special concrete foundations and vertical posts were eliminated by attaching the supporting legs of this orifice meter chart to brackets welded to the orifice flanges. In this manner, the recorder support may be taken along with the orifice for hookup anywhere.

The supporting bracket was made from 2-inch pipe. In order to make it possible to change plates easily, horizontal brackets welded to the flanges had to be extended about 12 inches as shown. A cross member tied the two brackets together to form a foundation for the vertical support. A mercuryless type meter was then mounted on this

Check the SAFETY ZONE

Yes . . . check the safety zone before ordering valves. Check . . . for voids in the body that could retain fluid when the valve is closed or open.

LISTED UNDER UL REEXAMINATION SERVICE UNDERWRITERS' LABORATORIES, INC. TYPE "G"

ORBIT VALVES ®

ORBIT Forged Steel LP GAS VALVES are designed so that there are no voids in the body of the Valve, for fluids to become trapped that could feed a fire or contaminate a different product. When the valve is closed it drains clean.

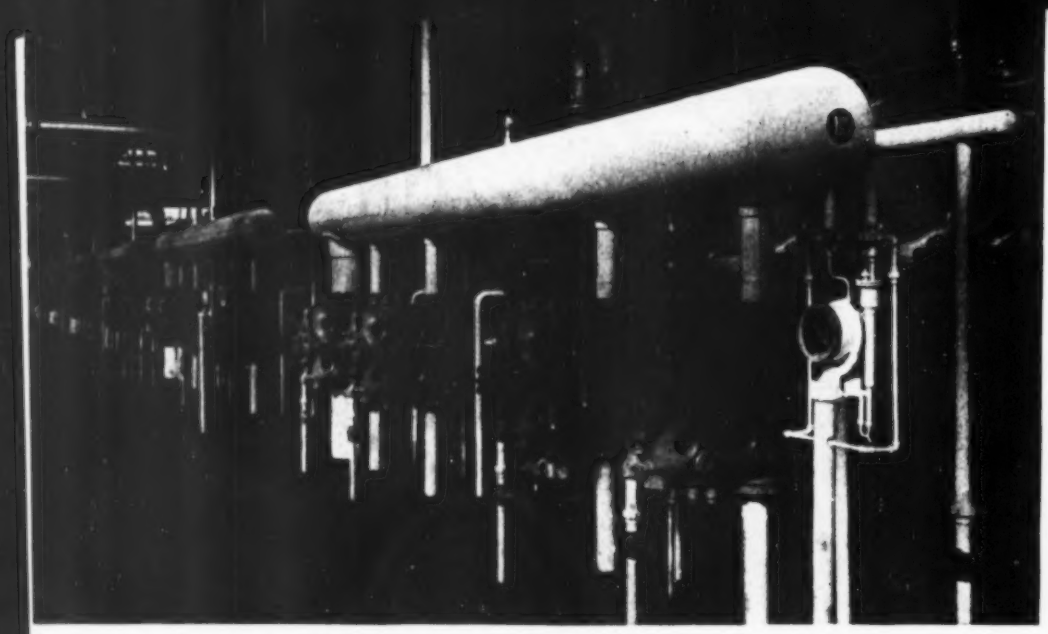
Your Supply Store carries ORBIT Forged Steel Valves in stock. Sizes 1" to 4". ASA Ratings 150 lb. Class to and including ASA 2500 lb. Class. Screwed and Flanged Ends. Maximum Rated Working Temperature 250 Fahrenheit.

BRANCHES

HOUSTON, TEXAS, 407 Velasco
(Serving the Gulf Coast)
ODESSA, TEXAS, 402 West County Road
(Serving West Texas)
CASPER, WYOMING, 1740 E. Yellowstone
(Serving the Rocky Mountain States and Canada)

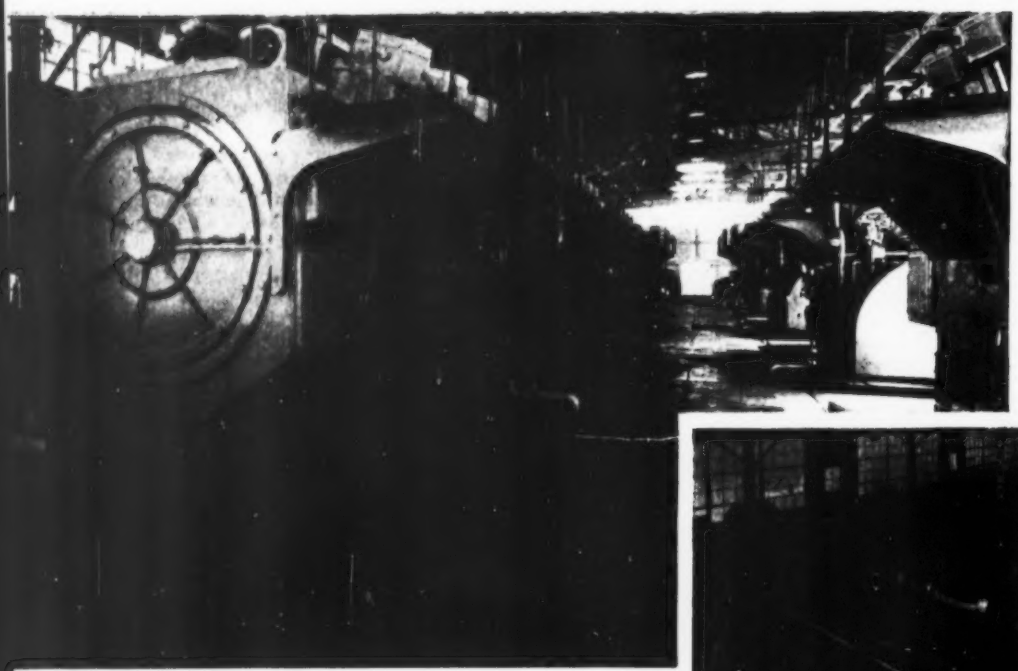
ORBIT VALVE COMPANY

P. O. BOX 699 **TULSA, OKLA.**

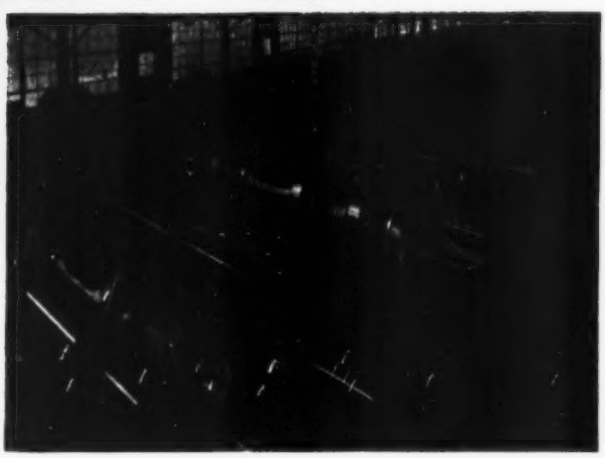


One of the latest Cooper-Bessemer V-angle installations on the El Paso Natural System — big, space-saving GMW units in the Keystone, Texas, main line gas transmission station.

Another Example of Efficient Power at Lower Cost



Line-up of seven of the seventeen GMV-10's installed from 1948 through 1950 in El Paso Natural's modern Deming station, Gage, N. M.



El Paso Natural's experience with Cooper-Bessemers started 16 years ago with this installation of seven then-modern Type 19 horizontals in their No. 1 station.

COMPRESSORS-GAS ENGINES-DIESELS

New York Washington, D. C. Bradford, Pa.

San Francisco, Cal. Houston, Dallas, Gregston, Pampa and Odessa, Texas Seattle, Wash.

COOPER-BESSEMER HORSEPOWER MULTIPLIES 40 TIMES IN 16 YEARS

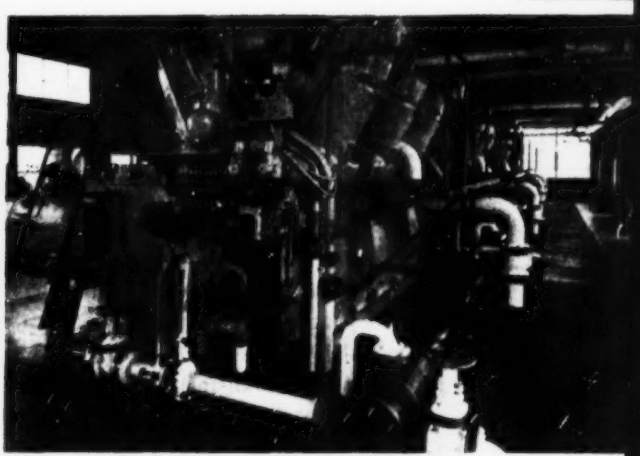
On El Paso Natural's System

. . . AND RUNS THE GAMUT OF SERVICES!

● El Paso Natural Gas Company's remarkable growth through the years is today being climaxed by one of the largest gas pipe line expansion programs ever undertaken. If reliable, efficiently operating compressor equipment has some bearing on this success, as it must, look at the Cooper-Bessemer record . . . Back in 1937, El Paso Natural's No. 1 station was powered with Cooper-Bessemers—seven Type 19 horizontals totalling 5250 compressor horsepower. Today, Cooper-Bessemers throughout the system exceed 200,000 horsepower! And in 1940 El Paso Natural was one of the first to take advantage of a new idea in compressor design — Cooper-Bessemer V-angles. Now, these modern, compact units . . . GMV's and big GMW's alone comprise over 191,000 compressor horsepower . . . on their main lines, in gathering service, in gasoline extraction, handling residue gas and for repressuring.

Perhaps you should bear this in mind . . . with thermal efficiencies from 30 to 40 per cent, you'll find Cooper-Bessemers unmatched in fuel economy . . . unmatched, too, in the many other factors that add up to outstanding over-all economy. Why not discuss your requirements with the nearest Cooper-Bessemer office?

Rated 600 hp each, these three efficient Cooper-Bessemer JS-8 gas engines drive generators in El Paso Natural's power plant at Wasson, Texas.



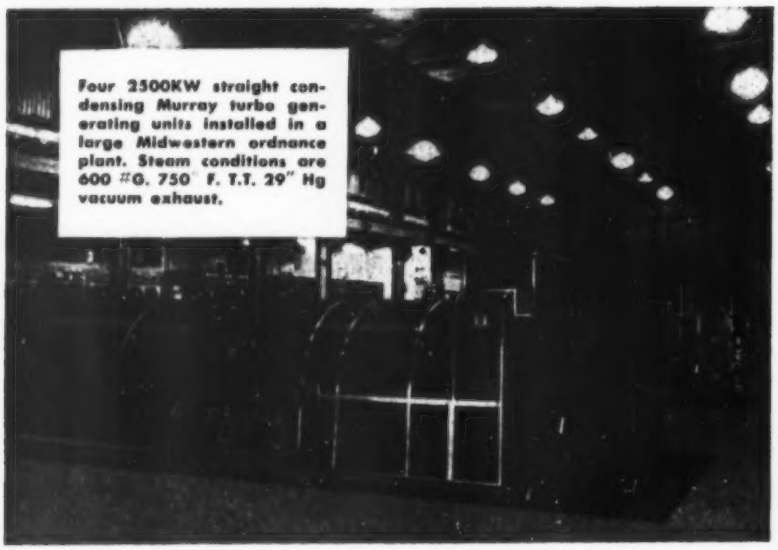
Line-up of four Cooper-Bessemer GMV-6 V-angles in El Paso Natural's gas booster station at Snyder, Texas.

by **Cooper-Bessemer**

MOUNT VERNON, OHIO AND GROVE CITY, PENNA.

Tulsa Shreveport St. Louis Los Angeles Chicago

Murray Turbines



Four 2500KW straight condensing Murray turbo generating units installed in a large Midwestern ordnance plant. Steam conditions are 600 #G. 750° F. T.T. 29" Hg vacuum exhaust.

● Murray Turbo Generator units can be furnished to meet your special requirements in sizes up to 3000KW. Condensing and non-condensing types with or without extraction and/or mixed pressure features can be furnished. Whether you require a small inexpensive standby unit or a highly efficient, and reliable source of power, Murray has a design to fit your needs. Consult your local Murray representative who will gladly help you select the unit most economically suited to your conditions.

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA

Builders of Steam Power Equipment for Three Quarters of a Century

How to Do It . . .

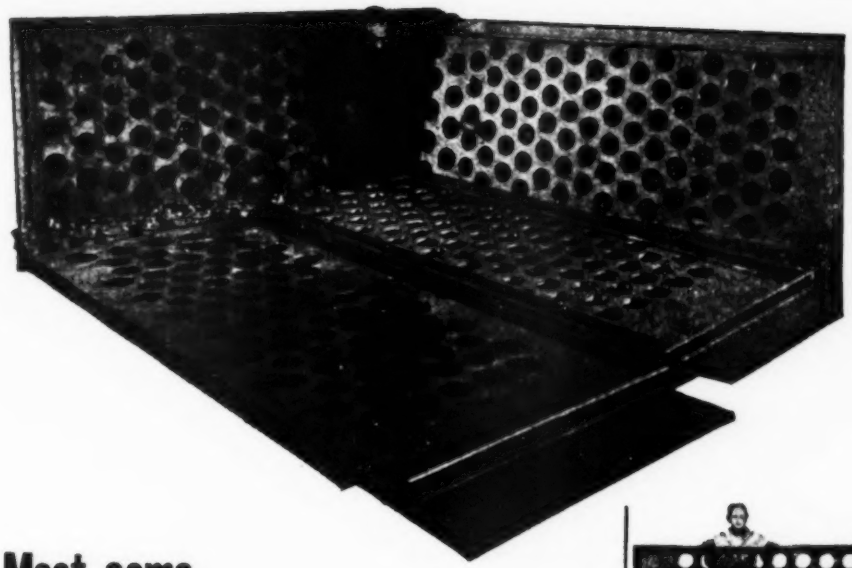
2-inch upright member.

Of interest in this particular installation are the unusually largte scrubbers used on the pressure lines to the recorder. Of 2-inch pipe, these scrubbers are about five feet in length and are supported by the pressure taps into the orifice body. Bottom of each scrubber contains a needle valve so the chamber may be drained periodically of any liquids trapped. One scrubber connects to the downstream pressure tap, while the other ties into the upstream pressure connection.

Although the 2-inch riser supporting the recorder may not be exactly vertical, four adjustment screws on the cap that fits over the support make possible fine adjustments that place the meter exactly in a vertical position.

Clevises Eliminate Bolts In Erection of Pipe Rack

When erecting a pipe rack on each side of the walk, the various sections can be attached to each other without the use of bolts or welded seams. On each side of the main sills, which ride upon channel iron as a base, are clevis type lugs so that wings of the rack can be installed by inserting single lugs between the pairs of lugs, forming the clevis, on the side rails. Tying the parts together is done with dowel pins secured near their operating position with chains. Similar clevises are attached to the vertical posts of the main sections to extend the rack to a size accommodating the requirements. All wings and panels have identical ends, and each panel is identical so that it can be set at any point without numbering or otherwise identifying separate panels.



Tube Sheets of 25% chromium-12% nickel alloy, produced by NATIONAL ALLOY DIVISION, BLAW-KNOX COMPANY, Blawnox, Pa. Weight: 1150 lbs. each, as cast.

Meet some Heat-Resistant Nickel Alloyed Castings

SERVING AT TEMPERATURES UP TO 1800° F.

Useful life of cast parts in refinery equipment may be greatly extended despite attack by chemicals and atmospheres over a wide range of concentrations, pressures and temperatures.

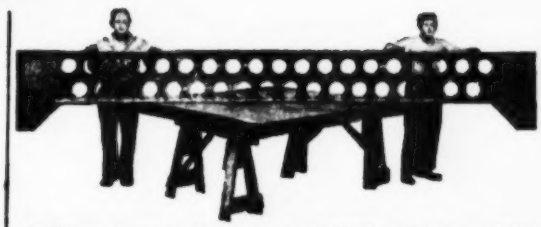
An answer to the problem is found in castings that have chromium, nickel and iron as major constituents. Because this type of material is characterized by unusual strength at elevated temperatures along with outstanding resistance to high temperature corrosion.

Three typical cast parts...capable of sustained use under severe operating conditions... are shown to illustrate the use of cast nickel-chromium iron alloys.

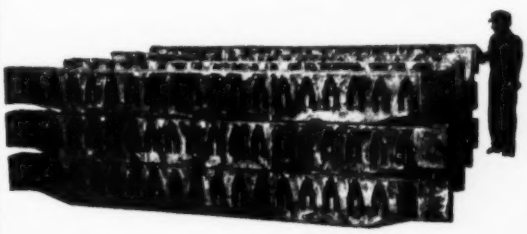
Other applications include refinery furnace frame and door assemblies, furnace burner nozzles, heat exchangers, tube supports, manifolds for cracking stills, and similar refinery components.

Nickel in various percentages and in conjunction with other alloying elements, imparts strength, toughness, resistance to wear, heat and corrosion.

Consult us on the use of alloys containing nickel in your equipment. Send the coupon for your copy of "Heat and Corrosion Resistant Alloy Castings in Industry."



Refinery Furnace Beam cast of 25% chromium-12% nickel alloy for use at temperatures of 1500°-1800°F. This 960-pound beam, 16' long, is a product of THE COOPER ALLOY FOUNDRY CO., Hillside, N. J.



Air Headers for catalytic cracking kilns operating at 1400°-1600°F. Used in catalysts, these 25% chromium-12% nickel alloyed castings, assembled by welding, generally last 4 years in this service. Weight: 2120 lbs. each. Produced by THE BABCOCK & WILCOX COMPANY, Barberton, Ohio.

INCO

The International Nickel Company, Inc.
Dept. 20, 67 Wall Street, New York 5, N. Y.

Please send me booklet "Heat and Corrosion Resistant Alloy Castings in Industry."

Name _____

Title _____

Company _____

Address _____

City _____ State _____

PR 2-51

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.

What's Happening in the Industry . . .

Downey and Fleer Fill New Shell Chemical Posts

New head office posts have been set up by Shell Chemical Corporation to

Fleer Downey

help meet the demands of its manufacturing activities. Named to fill the new positions are B. M. Downey, manager of the company's plant at Houston, and A. W. Fleer, manufacturing operations manager.

As the new manager of manufacturing, Downey will be in charge of managers of plants at Houston, Denver, Colo., Norco, La., and Martinez, Dominguez and Torrance, Calif. He will also be in charge of the head office Manufacturing Operations and Industrial Hygiene departments.

As the new manager of research, development and engineering, Fleer will be in charge of the company's research, economic evaluation and process engineering activities, as well as the engineering, design and construction of new plant facilities.

Downey joined Shell in 1925 at Martinez. Fleer at St. Louis in 1925.

Beckman Lauds Oil Firms For Part in Smog Fight

The petroleum industry has made great progress in its efforts to reduce contaminants in air, Dr. Arnolds O. Beckman, head of Beckman Instruments, Inc., declared recently at a session of California Governor Goodwin J. Knight's smog conference.

Speaking as head of a five-man technical committee, Beckman analyzed what has been done, is being done and what remains to be done. Regarding the relative blame of refineries and automotive exhaust, he said, "We are not trying to get involved in trying to fix blame on a percentage basis because nobody has the answer. We can say this: refineries have been installing devices to reduce hydrocarbons and noxious gases and have made great progress and are continuing to make progress."

Spering, Matthies Resign At PAD; Successors Named

Howard S. Spering and Arnold C. Matthies, assistant directors of the Refining and Natural Gasoline division of the Petroleum Administration for Defense, have resigned. Spering, who joined PAD in April, 1951, will practice law in Washington, and Matthies will return to Esso Standard Oil Company at Baton Rouge, La.

Roy P. Wilson, chief of the Refining Technology branch, and Albert L. Anderson, chief of the Aviation Fuels branch and the Petroleum Products Supply branch, will succeed to the vacated posts.

Ashland Oil Elects Williams Vice President

John Fred Williams, personnel director of Ashland Oil & Refining Company, has been elected vice president. Associated with the company since January, 1948, he was named personnel director in August, 1950.

Williams

Prior to joining Ashland, Williams was superintendent of public instruction of Kentucky from 1944 to 1948 and superintendent of Johnson County Schools in Kentucky. He received the Award of Merit for outstanding educational service from Kentucky Association Colleges and Secondary Schools in 1945.

Standard of Indiana Assigns Miller to Mandan

Irvin E. Miller, who joined Standard Oil Company (Indiana) in its Research department at Sugar Creek, Mo., in 1944, has become superintendent of Standard's laboratory at the Mandan, N. D., refinery, which is now under construction. He has been succeeded as group leader at Standard's Sugar Creek laboratory by B. J. Duffy, Jr., who joined the company as a chemical engineer at Sugar Creek in 1948.

Program Listed for API Refining Meet

Technologists, refiners and industry executives in large numbers are expected to flock to Houston next May 10-13 for the Nineteenth Midyear Meeting of the Division of Refining of the American Petroleum Institute.

The four-day conclave will be held at the Rice Hotel and will include 12 technical group sessions and an open dinner session. Subjects to be covered at the sessions include analytical research, refinery maintenance, waste disposal, motor fuels and petrochemicals.

Program for the meeting as released by the Division of Refining follows:

MONDAY, MAY 10

9:00 a.m.—Analytical Research

Presiding: C. E. Headington, The Atlantic Refining Company. "Operation of a Petroleum Research Analytical Laboratory," W. C. Schaefermeyer and E. S. Smith, Union Oil Company of California. "Determination of Mercaptans by an Amperometric Method," M. D. Grimes, J. E. Puckett and B. J. Newby, Phillips Petroleum Company. "High Efficiency Laboratory Fractionating Equipment," J. C. Winters and R. A. Dinerstein, Standard Oil Company (Indiana). "New Techniques for Analyzing Mixtures of Trace Metals," R. M. Sherwood and F. W. Chapman, Atlantic Refining. "A Hydrogen Sulfide Analyzer Recorder," E. B. Offutt and L. V. Sorg, Standard of Indiana. "Micro Distillation Methods for Analysis of Petroleum," A. R. Javes, C. Liddell and W. H. Thomas, Anglo-Iranian Oil Company, Ltd. "A Reduced Scale Reid Vapor Pressure Apparatus," R. L. LeTourneau, J. F. Johnson and W. H. Ellis, California Research Corporation. "Determination of Water in Acetaldehyde by Infrared Spectroscopy," J. A. Favre and J. B. Butler, Phillips Petroleum.

9:00 a.m.—Corrosion

Presiding: L. W. Robbie, Republic Oil Refining Company. "Corrosion and Prevention in Heat Exchangers in Cooling Water Service," J. D. Munro, Standard Oil Development Company. "Selection of Paints and Application in Combating Atmospheric Corrosion," F. T. Radecke, Shell Oil Company. "Hydrogen Chloride Evolution from Crude Oils as a Function of Salt Concentration," G. J. Samuelson, Petrolite Corporation.

2:00 p.m.—Analytical Research

Presiding: R. J. Askevold, The Pure Oil Company. "Tetraethyl lead in Gasoline: A Review of Analytical Methods," C. M. Gambrill and Sue A. Generaalik, Ethyl Corporation. "Rapid Colorimetric Method for Phenyl Alpha Napthyl Amine in New and Used Oils," W. S. Levine, Sacony-Vacuum Laboratories, Inc. "Spectrochemical Determination of Copper in Crankcase Drainings," J. Hansen and C. R. Hodgkins, Standard Oil Development. "Determination of Trace Amounts of Iron, Nickel and Vanadium on Catalysts by X-Ray Fluorescence," G. V. Dyroff and P. Skiba, Standard Oil Development. "Non-Metal Analysis of Micro Quantities of Solids by Means of the Emission Spectrum," E. L. Gunn, Humble Oil & Refining Company. "Spectrographic Methods for Analyzing Lubricating Greases," C. W. Key and G. D. Hogan, Richfield Oil Corporation. "Spectrographic Analysis of Petroleum Products and Related Materials," L. L. Gent, C. P. Miller and R. C. Pomatti, The Texas Company. "Application of the Logarithmic Sector to Semi-Quantitative Spectrographic Analysis of Petroleum Ash Residues," E. B. Childs and J. A. Kanehann, Socony-Vacuum Laboratories.

2:00 p.m.—Training

Presiding: G. R. Bryant, Texaco. "Basic Management Training for Hourly Employes," W. E. Bennett, Cities Service Refining Corporation. "How to Train Your Subordinates," Richard E. Crow, Continental Oil Company. A paper—title to be announced, L. R. Boulware, General Electric Company.

TUESDAY, MAY 11

9:00 a.m.—Refinery Maintenance

Presiding: Bonner H. Barnes, Gulf Oil Corporation. "Minimizing the Refinery Maintenance Crew," F. C. King, General Petroleum Corporation. "The Use of Technically Trained Men in Refinery Maintenance Work," D. G. Debo and J. G. Houseman, Standard of Indiana. "A Correlation of Manpower Requirements, Maintenance Requirements and Equipment Selection," J. S. Dalton and M. A. Pappas, The Standard Oil Company (Ohio). "Effective Control of Storehouse Operation," J. H. Anderson, Humble.

2:00 p.m.—Refinery Maintenance

Presiding: Clarence H. Thayer, Sun Oil

WHAT IT IS! Wolverine Trufin Bi-metal is an aluminum finned tube having a liner of a different metal. *The entire fin construction is all one piece of metal.* Its fins are extruded right from the tube to greatly increase its outside surface.

THE FIRST REASON FOR SPECIFYING WOLVERINE BI-METAL: You have a choice of liner. The inside can be any corrosion-resistant alloy you may require to meet your specific condition.

THE SECOND REASON: Because the fins are integral, Trufin possesses greater heat transfer abilities in less space.

THE THIRD REASON: By virtue of this integral fin construction, Trufin has the stamina to stand up under vibration and sudden temperature changes.

THE FOURTH REASON: Because of the aluminum fin construction, Trufin bi-metal is light weight.

THE FIFTH REASON: Trufin can be fabricated, coiled or otherwise fabricated just like plain tube.

Trufin can be had also in aluminum, all copper or copper-base alloys, electric-welded steel and other metals.

All types come in a variety of fin heights and spacings. Send for our new Condenser Tube Book giving all specifications. WOLVERINE TUBE DIVISION of Calumet & Hecla, Inc. 1437 Central Ave., Detroit 9, Michigan.

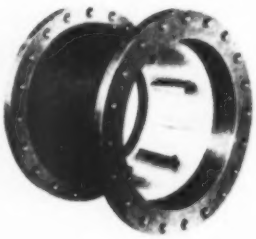
*REG. U.S. PAT. OFF. †A PATENTED PROCESS RE 22,685

Wolverine Trufin and the Wolverine Spun End Process† available in Canada through the Unifin Tube Co., London, Ontario*

WOLVERINE TUBE DIVISION
OF CALUMET & HECLA, INC.
Manufacturers of Quality Controlled Tubing

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA • Sales Offices In Principal Cities
EXPORT DEPT., 13 E. 40th ST., NEW YORK 16, N. Y.

Flow Tubes—For Accuracy in Metering



The Flow Tube is an impact-type head meter designed for accurate measurement and regulation of fluid flow. It consists, essentially, of a short spool piece, the inner periphery of which is equipped with two groups of pressure nozzles, one group pointing upstream and the other downstream. The nozzle groups are inter-connected by common pressure rings from which connections are made to the high and low pressure sides respectively, of a conventional indicating, recording or integrating meter. Flow Tubes differ from other variable head meters in that the taps are located at points of equal cross-sectional area. Therefore, the differential developed is a function of the velocity head and independent of the static head.

Flow Tubes are compact, comparatively light weight, relatively low in cost, and are easy to install since they require straight runs entering and following only when installed near throttling valves or regulators. And. Flow Tubes are available in types and D/d ratios to provide differentials that can be accurately measured with the least head loss.

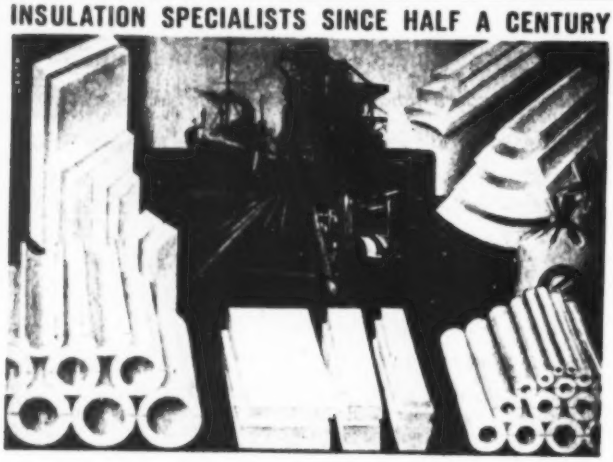
Flow Tubes are furnished with head capacity curves based on laboratory tests. These data furnished with each Flow Tube makes our guarantee of exceptional metering accuracy possible.

For further information, write us, and for specific recommendations, send us necessary flow data.

FOSTER ENGINEERING COMPANY

835 LEHIGH AVE. UNION, N. J.

INSULATION SPECIALISTS SINCE HALF A CENTURY



We supply the material and the men to handle it.
Contractors for heat and cold insulation all over the world.
Suppliers and exporters of all kinds of insulation materials for oil refineries a.o.

Magnesia 85 % - Rockwool - Asbestos - Cork

For all temperatures, in sections, blocks, segments, sheets, blankets and plastic form.

All finishing materials.

INTERNATIONAL TECHNICAL TRADING COMPANY **CLETON LTD.**

SCHIEDAM - NETHERLANDS
cable address Cletontrading

What's Happening. . .

Company. "Area Supervisor System as Applied to Baton Rouge Refinery," O. R. Minton, Esso Standard Oil Company. "Panel Session—Planning for Major Unit Turnarounds," C. H. Trotter, Phillips Petroleum, E. C. Newton, Atlantic, J. T. Tippit, Texaco, and A. C. Collins, Shell Oil.

7:00 p.m.—Oil Storage Tank Failures

Presiding: R. G. Sanders, Magnolia Petroleum Company. "Brittle Failure of Steel Structures—A General Engineering Problem," Prof. M. E. Shank, Massachusetts Institute of Technology. "Results of the Survey of Study Group on Oil Storage Tank Failures," members of the study group, C. H. Samans, chairman, Standard of Indiana. "Some Economic Aspects of the Oil Storage Tank Failure Problem," F. A. Gitzendanner, Standard of Indiana. "The Standard Oil Development Company Study of Brittle Failure of Tank Steels," F. J. Feely, Jr., and M. S. Northup, Standard Oil Development.

WEDNESDAY, MAY 12

9:00 a.m.—Waste Disposal

Presiding: C. C. Tate, Phillips Petroleum. "Chemical Flocculation of Refinery Wastes," R. F. Weston, Atlantic. "Planning and Execution of an Oil Refinery Waste Survey," A. P. Dennis, Jr. "New Oil Reclamation and Waste Disposal Facilities," J. F. O'Reilly, Skelly Oil Company. "Preferential Withdrawal of Catalyst Fines to Reduce FCC Stack Losses," D. L. Cleveland, Shell Oil. "Catalytic Combustion of Refinery Waste Gases," David B. Ardern, Houdry Process Corporation. "Status Report on Research Program of the Smoke and Fumes Committee," Vance N. Jenkins, Union Oil Company of California.

9:30 a.m.—Motor Fuels

Presiding: Bruce K. Brown, Pan-Am Southern Corporation. "The Contribution of Surface Combustion of the Fuel to Preignition," R. E. Wilson, F. W. Bowditch and G. J. Nebel, General Motors Research Laboratories. "The Preignition Resistance of Fuels," R. M. Sturgis, E. N. Cantwell, W. E. Morris and D. L. Schultz, E. I. du Pont de Nemours and Company. "The Selection of Fuel Additives to Reduce Preignition," F. C. Burk, L. J. Test, and H. R. Jackson, Atlantic. "The Measurement and Chemical Control of Preignition in Engines," J. S. Wintringham, J. R. Hincamp, and H. A. Toulmin, Ethyl.

2:00 p.m.—Petrochemicals

Presiding: Harold G. Osborn, Continental Oil. "Petrochemicals—Glamour Girl or Problem Child," G. B. Ryan, V. A. Brietenbach, Sohio, and H. K. Sleuwenhius, consultant. "Isobutylene Manufacture Using Sulfuric Acid Process," G. P. Baumann and M. R. Smith, Standard Oil Development. "Simultaneous Extraction of Benzene and Toluene by the Sulfur Dioxide Process," Strobel and Kodar, Continental Oil. "Large-Scale Manufacture and Distribution of Ethylene," P. W. Cornell, W. H. Litchfield, and H. M. Vaughan, Gulf.

7:00 p.m.—Open Dinner Session

Presiding: John W. Newton, vice president for Refining, API, and Magnolia Petroleum. Opening Remarks: John W. Newton. "Recognition of Executive Ability in Yourself and Others," Robert F. Pearse, Worthington Associates.

THURSDAY, MAY 13

9:00 a.m.—Processes

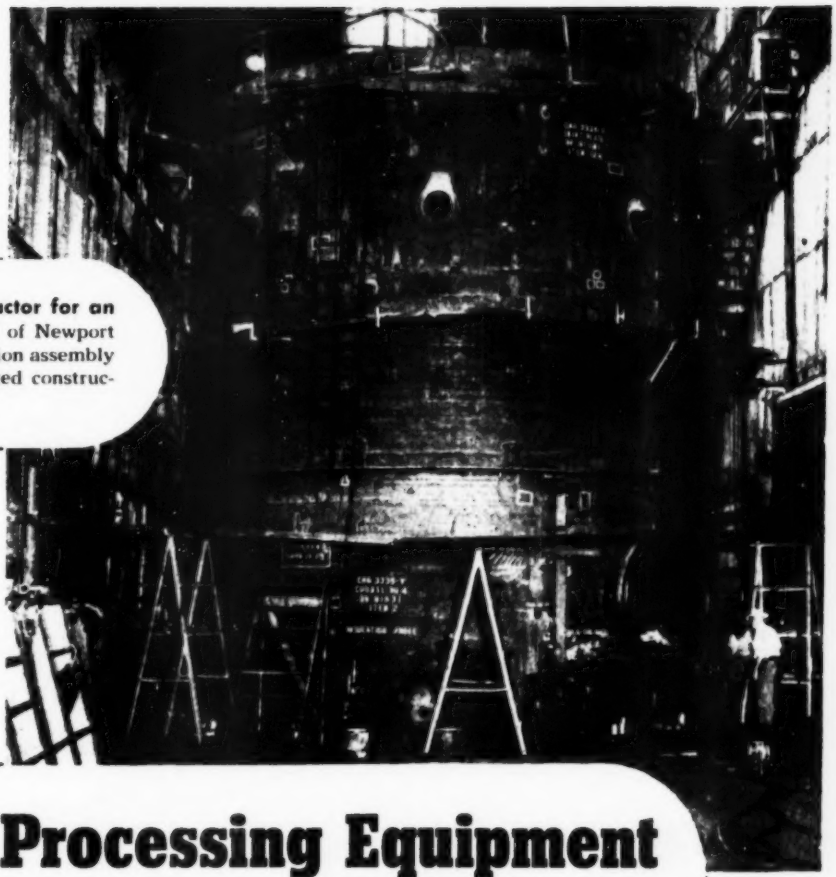
Presiding: H. D. Wilde, Humble. "Dual-layer Refining of Distillate Fuel Oils," C. A. Duval, R. T. Malin, and V. A. Kallchevsky, Magnolia Petroleum. "Factors in Selecting a Catalytic Reforming Process," J. A. Rocf, W. R. Hertwig, L. W. Russum, and R. A. Steel, Standard of Indiana. "A Model H Fluid Hydroformer and Its Application," E. W. Nicholson, Esso Standard. "Hyperforming," Clyde Berg, Union Oil.

2:00 p.m.—Fractionation

Presiding: C. P. Baker, Socony-Vacuum Oil Company. "Fractionation Equipment Sizes for Refinery Feed Stocks," G. T. Atkins and G. W. Wilson, Humble. "Behavior of Binary and Ternary Mixtures During Continuous Distillation," M. R. Fenske, Pennsylvania State University, and Norman Kirk, General Electric Company. "The Performance of Catalytic Units Fractionating Towers," G. S. Hoagland, E. J. Lemieux and W. C. Schriener, The M. W. Kellogg Company. "Hydraulics of Tray Design," Prof. R. L. Huntington, University of Oklahoma.

Humble Advances Stewart

H. M. Stewart has been promoted to engineering associate in Humble Oil & Refining Company's Engineering divi-



Course number four of a reactor for an overseas oil refinery. Typical of Newport News plant methods, the precision assembly of this unit in the shop expedited construction of the reactor in the field.

Petroleum Processing Equipment

...Built by Specialists in Metal Fabrication

Careful attention to detail characterizes the work of Newport News craftsmen...

They've fabricated millions of tons of steel including corrosion-resistant alloy, clad and other special steels for many diverse industries.

Newport News handles the job exactly as you want it done, for maximum results per dollar invested.

Specialized production techniques, advanced plant methods and a complete range of facilities along with many special purpose machines contribute to the excellence of Newport News fabrication.

Let us bid on equipment for your present or future projects. Learn how Newport News can help you...send for our booklet entitled "Facilities and Products." It's yours for the asking.

Newport News Shipbuilding and Dry Dock Company

Newport News, Virginia

CHASE

PIN-POINTING TROUBLE BEFORE IT STARTS!

By expanding Antimonial Admiralty Heat Exchanger Tubes over a tapered pin in the laboratory, Chase metallurgists check the ability of the tube to withstand expanding and flaring operations during installation.

Another reason why

Chase

Antimonial Admiralty Heat Exchanger Tubes last longer!

For heat exchanger tubes that stay on the job year in, year out, insist on Chase Antimonial Admiralty.

What's the secret? *Enough* antimony to resist dezincification effectively. Does antimony adversely affect the strength or other properties of admiralty? Definitely not! The antimony imparts corrosion resistance which assures long life under many different water conditions.

So, whether you're replacing heat exchanger tubes, or planning a new installation, specify Chase Antimonial Admiralty!

CHASE WAREHOUSE STOCKS: New Orleans, Los Angeles. Also carried by Vinson Supply Co., Tulsa; Standard Brass & Mfg. Co., Houston.

Chase BRASS & COPPER

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

The Nation's Headquarters for Brass & Copper

Albany†	Cleveland	Kansas City, Mo.	New York	San Francisco
Atlanta	Dallas	Los Angeles	Philadelphia	Seattle
Baltimore	Denver†	Milwaukee	Pittsburgh	Waterbury
Boston	Detroit	Minneapolis	Providence	
Chicago	Houston	Newark	Rochester†	(†sales office only)
Cincinnati	Indianapolis	New Orleans	St. Louis	

What's Happening. . .

sion at Baytown, Texas. In this post he will be concerned with longrange development and modernization of the utility system in the Baytown refinery. He joined Humble's Engineering division in May, 1930.

Chemists Institute Award Will Go to W. J. Sparks

Dr. William J. Sparks, co-inventor of Butyl synthetic rubber, has been selected to receive the 1954 Gold Medal of The American Institute of Chemists. Dr. Sparks, director of the Chemical division and coordinator of Exploratory Research for Standard Oil Development Company, is the twenty-sixth recipient of the annual award.

Sparks

The medal will be presented to Dr. Sparks at the Institute annual meeting at Asbury Park, N. J., next May. The Institute's medal award committee cited Dr. Sparks as "an eminent chemist who has striven unceasingly for the promotion of the science of chemistry and the professional advancement of the chemist."

Dr. John C. Warner, president of Carnegie Institute of Technology, was the 1953 recipient.

Dow Promotes Gillespie To Assistant to President

W. Tyrone Gillespie, an attorney in the Legal department of The Dow Chemical Company, has been advanced to assistant to the president, the second such post on the president's staff. He will also retain his present duties in the Legal department.

Gillespie entered Dow's employ in 1942. From 1943 to 1946 he served in the Military Police Corps. He then engaged in law practice until returning to Dow in 1948.

Pan American Starts Work On New High Pressure Lab

Construction of a new high pressure research laboratory has started at Pan American Refining Corporation, Texas City, Texas. The structure is expected to be completed within four to five months.

Chemical reactions under high pressure will be studied in the new building, which will be located adjacent to Pan American's new research laboratory. The building, to have an area of 2000 square feet, will be constructed by H. K. Ferguson Company.

Conoco Names Mooney to Petrochemical Department

Richard S. Mooney has been appointed technical service representative for Continental Oil Company's Petrochemical department, with headquarters in New York.

Mooney has been a district sales man-

ANNOUNCING!

the **new**

Type "DE"

Coffin turbo pump

Superbly engineered to keep pace with increasing steam pressures, the new type "DE" is a highly efficient single-stage, high-speed, steam turbine-driven centrifugal boiler feed pump.

At *no extra cost*, unit is equipped with both a *speed-limiting governor* and a *pressure regulator* operated by a powerful oil relay which prevents over-speeding and provides shut-down upon loss of oil.

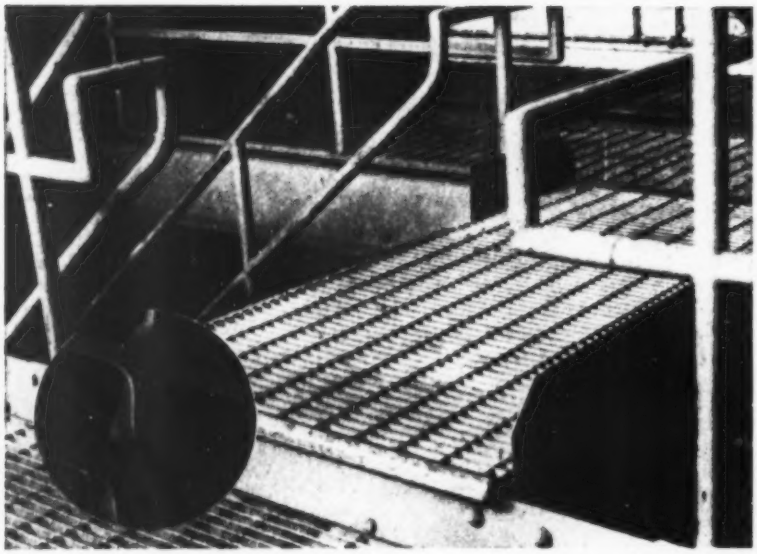
The unit has varied industrial uses, particularly in the oil and chemical fields for boiler feed and other services. The pump covers a Volumetric Range to 800 GPM, Discharge Pressure to 1000 PSIG, Steam Temperatures to 850° F., Exhaust Pressures to 80 PSIG, and Liquid Temperatures to 325° F. For special installations these ratings can be exceeded.

Write for the new, 6 page illustrated "DE" Bulletin PR 154.

THE **J. S. COFFIN, JR.** COMPANY

326 South Dean Street Englewood, New Jersey Cable Address: COFCO

Representatives in the United States, Canada, Europe, and the Far East



Grating by BLAW-KNOX

where do **you** need

steel grating?

There must be lots of places where you are now using grating—floors, platforms, walkways, catwalks and stair treads, for example.

But how about other uses—such as some sturdy shelving or a fan guard—or for covering a dangerous open pit or a light well. Take a good look around your plant and you'll probably come up with several jobs, including perhaps a new use, as steel grating is adaptable to many applications.

Any time you want some help on a job related to grating, we'll be glad to hear from you.

Only BLAW-KNOX Electroforged® Steel Grating and Stair Treads

—have these five exclusive features:

1. rigid one-piece construction—easy to install
2. all surfaces accessible—easy to paint
3. no sharp corners to clog—self-cleaning
4. maximum open area—for light and ventilation
5. non-slip twisted crossbar—safe footing

A short note will bring you a copy of new Bulletin No. 2365-R —a dimensional sketch will bring you a quotation.

BLAW-KNOX

BLAW-KNOX COMPANY

2005 Farmers Bank Building • Pittsburgh 22, Pennsylvania

BLAW-KNOX EQUIPMENT DIVISION
GRATING DEPARTMENT

GRATING APPLICATIONS: floors • platforms • walkways • catwalks • stair treads • fan guards • shelving • and many other uses, both outdoors and indoors, for versatile steel grating.

How to Do It...

ager with Great Lakes Carbon Corporation, Philadelphia, since 1951, and previously was associated for four years with Scott Paper Company in technical positions at Glenn Falls, N. Y., and Chester, Pa.

Rowand Honored for Contributions to Steam

William H. Rowand, vice president of The Babcock & Wilcox Company of New York, has been awarded the Newcomen Medal, which is given for achievement in the field of steam. The medal has been given only three times before in the history of the U. S. branch of The Newcomen Society.

Rowand

Foremost among Rowand's contributions to steam progress, which led to his nomination for the medal, was his invention in 1936 of the cyclone steam separator.

Cities Service Elevates McMurry and McConnohie

S. R. McMurry, manager of Cities Service Oil Company's Ponca City, Okla., refinery, has been transferred to the company's Bartlesville, Okla., headquarters on special assignment. D. R. McConnohie, assistant to the general superintendent of refining at Bartlesville, assumes McMurry's duties at Ponca City.

First employed by Cities Service in 1924, McMurry was transferred to Ponca City in 1950, after having served 20 years in various operational and supervisory positions in the company's East Chicago, Ind., refinery.

McConnohie joined Cities Service at its East Chicago refinery in 1936 as a pressure still operator. He advanced to assistant to the general superintendent at Bartlesville in 1951.

Carney Succeeds Bagsar in Top Sun Metallurgy Post

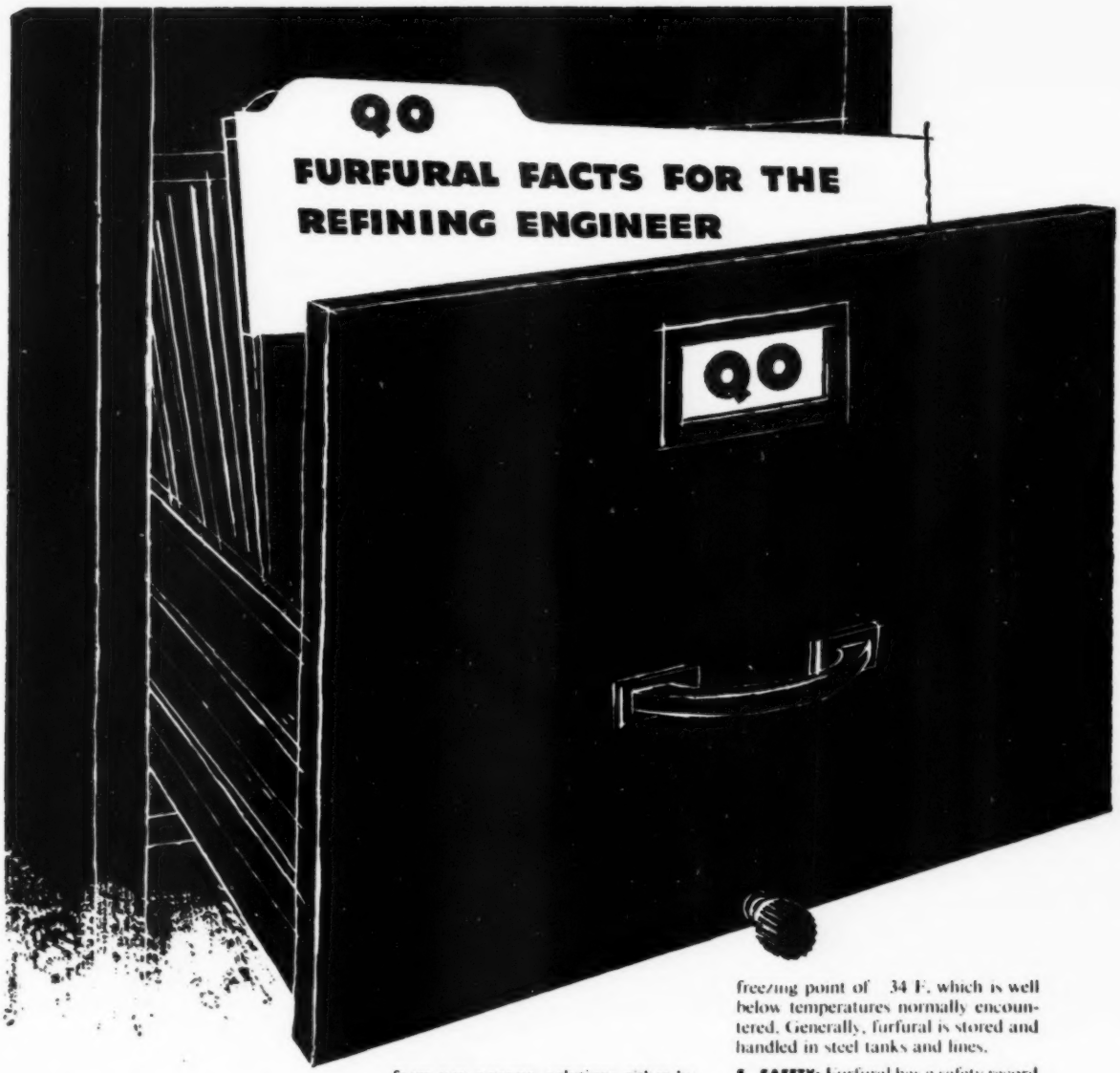
Aaron B. Bagsar, chief metallurgical engineer of Sun Oil Company, has retired after 22 years of service. Succeeding him is Joseph E. Carney, assistant chief metallurgical engineer.

Bagsar joined Sun in 1932 and has served in his present capacity ever since.

The new chief metallurgical engineer joined the Sun Metallurgical department in 1934 and was subsequently named chief inspector of the department. He was named assistant chief metallurgical engineer in 1951.

Blair Elected President Of Canadian Bechtel

Sidney M. Blair, of Toronto, has been elected president of Canadian Bechtel, Ltd., an affiliate of Bechtel Corporation. He has been vice president and a di-



What Makes Furfural So Good As a Selective Solvent?

1. SELECTIVITY: Furfural is highly selective: it is a polar molecule and gives a sharp separation. Its high specific gravity permits rapid phase separation.

2. EASE OF RECOVERY: Furfural is a stable compound and may be readily recovered from aqueous solution by steam stripping; it may be recovered from non-aqueous solutions either by flash vaporization, straight distillation, steam stripping, or extraction with water.

3. STABILITY: Under the conditions encountered in refining, furfural has a high degree of stability, as shown by the low solvent losses in operating plants around the world.

4. STORAGE: It is not necessary to use special handling precautions for cold weather operation since furfural has a freezing point of −34 F. which is well below temperatures normally encountered. Generally, furfural is stored and handled in steel tanks and lines.

5. SAFETY: Furfural has a safety record extending over 30 years of industrial use. It has a high flash point (150-160 F.), and a vapor pressure of 8 mm. Hg at 39.9 C.

6. COST: Furfural is low in price, and with high recovery, overall solvent costs are attractively low.

7. AVAILABILITY: Large quantities of furfural are produced the year around at three plants from raw materials which are replaceable yearly.

If you would like to know more about the properties of furfural, write for our Bulletin 203 "Physical Data on Furfural."

The Quaker Oats Company — **CHEMICALS DEPT.**

340C The Merchandise Mart, Chicago 54, Illinois
Room 540C, 120 Wall St., New York 5, N. Y.
Room 440C, P. O. Box 4376, Portland 8, Oregon

In the United Kingdom: Imperial Chemical Industries Ltd., Billingham, England
In Europe: Quaker Oats-Graanproducten N. V., Rotterdam, The Netherlands; Quaker Oats (France) S. A., 3, Rue Pillet-Will, Paris IX, France
In Australia: Swift & Company, Pty., Ltd., Sydney • **In Japan:** F. Kanematsu & Company Ltd., Tokyo

more and more refineries..... *
find KEY-KAST fittings and flanges
right for their alloy piping needs!

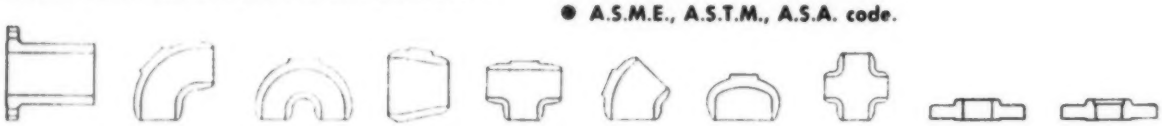
Key-Kast alloy welding fittings and flanges are available in low and intermediate alloys and various stainless steels.

* *a few* KEY-KAST *users:*

Gulf Oil Corporation
Union Oil Company of California
Phillips Petroleum Company
Sun Oil Company
Atlantic Refining Company
The British American Oil Co., Ltd.

HOW DO THESE ADVANTAGES FIT *YOUR* ALLOY PIPING NEEDS?

- **Greater wall thickness throughout—for increased structural strength.**
- ***Extra* thickness in critical areas—for greater allowance against corrosion and erosion.**
- **Controlled quality . . . through rigid metallurgical control.**
- **Low unit cost . . . plus prompt deliveries.**
- **A.S.M.E., A.S.T.M., A.S.A. code.**



Write for complete information and prices.

key company

Since 1916 . . . manufacturers and developers of products for high temperatures and pressures

P. O. BOX 494-E EAST ST. LOUIS, ILLINOIS

DISTRICT OFFICES: NEW YORK • CLEVELAND
CHICAGO • TULSA • HOUSTON • LOS ANGELES

rector of Canadian Bechtel and has been associated with Bechtel in Toronto since 1949.

Three Get New Posts at Standard Oil Development

Carl O. Tongberg has been appointed coordinator of research and development on products at Standard Oil Development Company, central research and engineering affiliate of Standard Oil Company (New Jersey). Tongberg was previously director of the Research division of Standard's Esso Laboratories, at the Esso Research Center at Linden, N. J. He will now be responsible for the company's activities on research and development on petroleum products.

Fleming

McNab

Tongberg

In promotions in the administrative staff of the Research division, made at the same time, Charles L. Fleming, Jr., formerly associate director, has become director of the division, and John G. McNab, formerly assistant director, has become associate director.

Humble Makes Additions To Baytown Refinery Staff

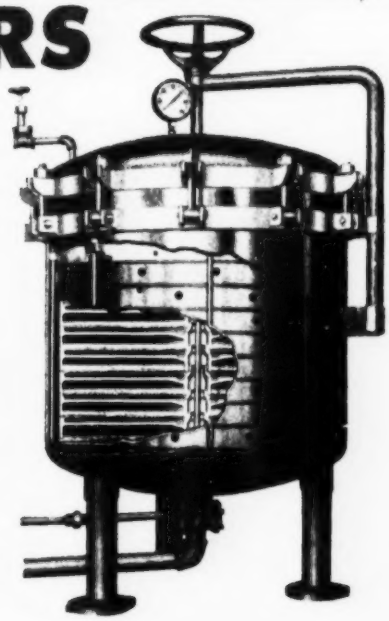
The following staff additions have been announced by Humble Oil & Refining Company's Baytown, Texas, refinery: J. J. Cunningham, B.S. degree in civil engineering, Georgia Institute of Technology, and J. T. Huffaker, B.S. degree in civil engineering, University of Tennessee, to Design department, Engineering division; F. W. Lampe, Ph.D. degree in chemistry, Columbia University, to Research & Development division; and Buford D. Smith, Ph.D. degree in chemical engineering, University of Michigan, and Wayne E. Stevens, Ph.D. degree in chemical engineering, University of Utah, to Technical Service division.

Fluor Retains Sherwood As Research Consultant

Thomas K. Sherwood, professor of chemical engineering at Massachusetts Institute of Technology, has been retained by The Fluor Corporation, Ltd., of Los Angeles, as a consultant to its

SPARKLER
HORIZONTAL PLATE
FILTERS

Noted for High Quality, Consistently Uniform, Fine Sharp Filtration of Petroleum Products....



Many times Sparkler filters have been chosen by experienced filtration engineers in the petroleum field because of these specific features of superiority.

Sparkler filters deliver unusually high flow rates due to the horizontal plate construction that requires only a very thin precoat to produce fine sharp filtration right from the start. Less pressure is required with a thin precoat resulting in a filter cake of less density and high flow capacity. Intermittent operation or variation in pressures will not disturb the stability of the filter cake.

Any grade of filter paper, cloth, or screens, and any filter aid can be used with maximum efficiency because no pressure is required to hold the filter cake on the plate.

Frequently Sparkler filters are used in the petroleum industry with various grades of paper only without filter aid to perform a specific job that would be difficult or impossible with some other types of filters such as the removal of water from diesel lube oil or transformer oil.

A few typical applications of Sparkler Filters to the Petroleum and petro-chemical industries for the filtration of:

- Canned lubricating oil
- Methyl-Ethyl-ketone
- Polyisobutane
- Chlorinated hydro-carbons (carbon tet.)
- Aviation gasoline
- Jet engine fuel
- Hydraulic oil
- Gas engine & diesel lubricating oil (both continuous recirculation on the engine and batch-wise)
- Diesel fuel oil
- Cooling tower water
- Plant effluent water (to obviate stream and lake pollution)
- Removal of Raney nickel from alcohol streams
- Insecticides
- Caustics & acids
- Cottrell precipitator insulating oil (carbon black plants)

Sparkler horizontal plate filters are available in capacities from 30 to 30,000 G.P.H. depending on type of product filtered. Can be supplied in carbon steel, stainless steel, pure nickel, or monel, bronze, Hastelloy and Inconel. Rubber lined, brine or steam jacketed.

Sparkler representatives for personal engineering service are located in Dallas, Houston, San Francisco, and other principal cities. Western Branch, Los Angeles, California.

SPARKLER

Write Mr. Eric Anderson for your nearest Sparkler service representative.

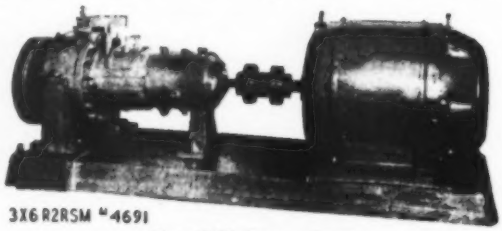
MANUFACTURING COMPANY
MUNDELEIN, ILL.

Sparkler International, Ltd. Prinsengracht 876 Amsterdam, Holland

MAKERS OF INDUSTRIAL FILTERS FOR OVER A QUARTER OF A CENTURY

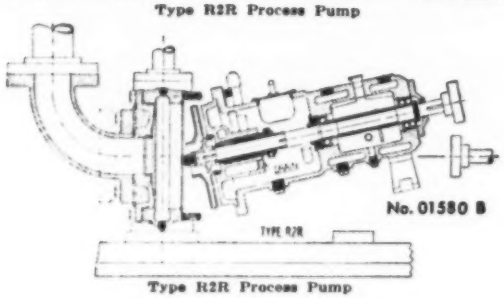
DEAN BROTHERS PUMPS INC.

Type R2R Centrifugal Process Pumps



3X6 R2RSM "4691

Type R2R Process Pump



Type R2R Process Pump

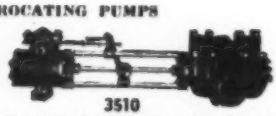
DISASSEMBLY: The Type R2R process pumps can be disassembled without disconnecting the suction and discharge piping. By first removing the spacer from the spacer type coupling, and unbolting the casing from the cradle the entire cradle and complete rotating element can be removed without disturbing the suction and discharge piping.

OPERATING RANGE: Type R2R. Heavy duty, process pumps are available in eighteen different sizes, enabling our engineers to furnish units specially designed and constructed for the particular work to be performed.
Capacities: 50 to 2000 Gallons per minute. Heads: Up to 400'. Speeds: 900 RPM to 4000 RPM.

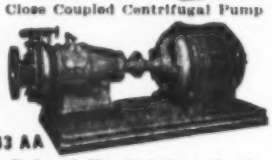
BUILDERS OF OUTSTANDING PUMPS SINCE 1869

CENTRIFUGAL and RECIPROCATING PUMPS

Close Coupled Centrifugal Pump

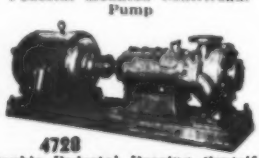


3510
Horizontal, Single Style, Double Acting, Piston Type, Close Clearance Pump. Designed to handle volatile liquids



4043 AA
Pedestal Mounted Centrifugal Pump

3833
Horizontal, Duplex, Double Acting, Side Pot, Piston Type, Oil Bath Power Pump



4720
Double Pedestal Bearing Centrifugal Pump

3556
Durable Duplex Packed Piston Pattern Steam Pump, Side Pot Type

ESTABLISHED 1869

DEAN BROTHERS PUMPS INC.

INDIANAPOLIS IND.

323 W TENTH ST.

Branch Offices: NEW YORK, N. Y., HOUSTON, TEXAS

Representatives in Principal Cities

What's Happening. . .

Research and Development division.

Sherwood, a director of Arthur D. Little, Inc., is also a consultant for other companies in the petroleum and chemical fields. In his capacity with Fluor he will consult on longrange research planning and advise in the prosecution of current projects.

Jersey Standard Assigns Fisher to Post in London

Harold W. Fisher, coordinator of the world-wide refining activities of Stand-

Fisher

Burks

ard Oil Company (Indiana) since 1950, has been appointed shareholder's representative for affiliates of the company in the United Kingdom. At the same time he was named chairman of the company's European Coordination Committee, with headquarters in London. In advancing, Fisher succeeds Howard W. Page, who became a director January 1.

Succeeding Fisher as coordinator of Jersey's refining activities is Dr. Harry G. Burks, Jr., Esso Standard Oil Company executive vice president. Burks is also a director of Standard Oil Development Company.

In addition to Fisher's appointment, Jersey appointed Paul J. Anderson deputy shareholder's representative for its United Kingdom affiliates, and D. E. Stines, vice chairman of the European Coordination Committee. Anderson has been the company's representative on the board of Iraq Petroleum Company and affiliates, while Stine has been its economics representative on the European Coordination Committee since January, 1953.

Hyde Made Refining Head Of Tide Water Associated

Herschel Y. Hyde, vice president in charge of manufacturing for the Western division of Tide Water Associated Oil Company, has been assigned the responsibility of planning and developing programs of the refining activities of all divisions of the company.

Hyde has been in the service of Tide Water Associated for 26 years, commencing as a research chemist in the company's refinery at Avon, Calif. Since 1946 he has served as vice president in charge of manufacturing, Western division.

Sohio Starts Work on Large Storage Caverns

Mining techniques are being used to create a series of large caverns 455 feet

What's Happening. . .

underground at the Lima, Ohio, refinery of The Standard Oil Company (Ohio) for the storage of 60,000 barrels of liquid propane and butane gasses.

Eugene Houdry Presented John Scott Medal Award

Dr. Eugene J. Houdry, famed internationally for his work in the development of the catalytic cracking of petroleum, was last month awarded the John Scott Medal Award of the Board of City Trusts of Philadelphia.

Houdry

The award is made to "ingenious men and women who make useful inventions," as prescribed by John Scott, a chemist of Edinburgh, Scotland, who established the award in 1816. It presently consists of $1000 and a copper medal and scroll.

Dr. Houdry, who retired as president of Houdry Process Corporation in 1948, did his pioneering work on catalytic cracking in France during the twenties.

Ohio Oil Advances Two At Robinson Refinery

H. E. Handy, a 30-year veteran with The Ohio Oil Company, has been appointed to the newly established post of manager of the company's Robinson, Ill., refinery. He is succeeded as refinery superintendent, a post he has held for the past seven years, by D. L. Winsett, assistant refinery superintendent.

Most of Handy's career with Ohio was spent at the Robinson refinery. He began with the company as an engineer in the Production department at Marshall, Ill., moving to Robinson in 1926 as a refinery engineer. He advanced to refinery superintendent in 1947.

Winsett was a chemist at Transcontinental Oil Company's Del Rio, Texas, refinery when Ohio Oil purchased the assets of Transcontinental in 1930.

Opposing Groups Form On Tricresyl Phosphate

Round one in what promises to be a long drawn-out verbal fight over the merits of gasoline additives of the tricresyl phosphate type, such as Shell Oil Company's TCP, was held last month at a meeting of the Society of Automotive Engineers. (See Who's Meeting, this issue.)

With Standard Oil Development Company attacking and Shell defending, the SAE skirmish provided the opportunity for opposing factions to air views which very likely have been developing for some time. The SAE encounter was over soon after it started but chances are that it will be followed by a great many more.

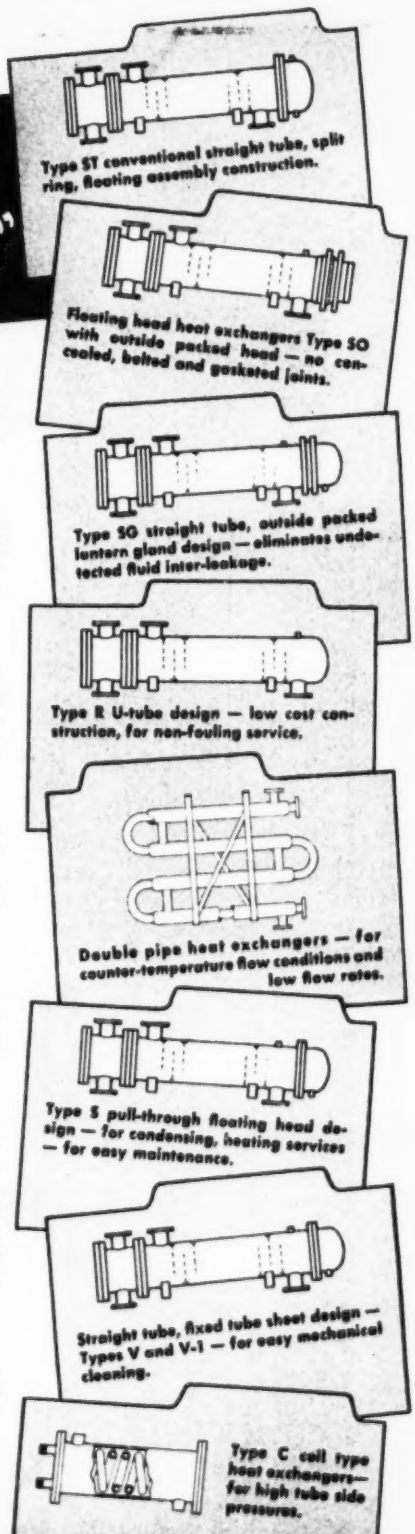
On one side of the controversy are Shell and other refining and marketing companies using TCP under Shell license, together with refiners and mar-

SAVE WITH WHITLOCK "STANDARDS"

It pays to consider Whitlock Standard Exchangers FIRST. You can make important savings with standard designs:

1. You save time — "prints for approval" are immediately available for your Engineering Department to use in planning piping and other layouts.
2. You save engineering costs — yet you obtain individual engineering attention to assure that the standard design selected is best fitted to your particular needs.
3. You save delivery time — units are manufactured from stocked materials and subassemblies. Many completed units are also maintained in stock.
4. You save on downtime — duplicate parts are readily available to answer emergency requirements and to reduce downtime.
5. You save on first cost — quantity-produced subassemblies and quantity-purchased materials reflect sizeable cost savings: our published price list is tempered by actual production experience. Consult this list and see how Whitlock Standard Exchangers can save you money.

Whitlock is ready to help you — send for new bulletin describing the complete line of Whitlock Standard Exchangers and outlining dimensions, capacities, and types of services. The Whitlock Manufacturing Co., 75 South St., Hartford 10, Conn.


Type ST conventional straight tube, split ring, floating assembly construction.
Floating head heat exchangers Type SO with outside packed head — no concealed, bolted and gasketed joints.
Type SO straight tube, outside packed lantern gland design — eliminates undetected fluid inter-leakage.
Type R U-tube design — low cost construction, for non-fouling service.
Double pipe heat exchangers — for counter-temperature flow conditions and low flow rates.
Type S pull-through floating head design — for condensing, heating services — for easy maintenance.
Straight tube, fixed tube sheet design — Types V and V-1 — for easy mechanical cleaning.
Type C coil type heat exchangers — for high tube side pressures.

WHITLOCK

Standardaire Blowers

Standardaire Blowers are designed to give dependable, trouble-free performance on a wide variety of refinery jobs. Compactly designed, the Standardaire Blower is an axial flow, positive pressure unit for handling gas or air under pressure or vacuum. Employing an exclusive principle of compressing air on a modified adiabatic cycle with lower mean internal pressure, the Standardaire Blower permits the greatest output per pound of weight ever achieved in this type of blower. With its wide range of pressures, it is essentially a high-speed unit which permits direct drive by standard motors. Through symmetrical generated rotors producing an air screw effect, air is taken in and discharged smoothly from pockets which form between the rotors, resulting in compression that is gradual and free from shock.

Read Standard also manufactures a complete line of chemical mixers for laboratory and industrial use. Write to

READ STANDARD CORP., YORK, PA

READ STANDARD CORPORATION

BLOWER-STOKER DIVISION
370 Lexington Avenue
New York 17, New York

What's Happening. . .

keters who have come out with their own tricresyl phosphate types of additives. On the other side are Esso Standard Oil Company and other companies who are relying on higher octane gasoline without such an additive to cure the motor ills for which TCP and its associated additives were prescribed.

1953 Engineering Award Given to Alexis Voorhies

Alexis Voorhies, Jr., director of the Esso Laboratories, Baton Rouge, La., is the recipient of the Louisiana Engineering Society's Technological Achievement Award for 1953.

Voorhies

The award is made annually to an engineer in the state for distinguished technological advancements or discoveries that contribute to the field of engineering. Voorhies was selected for the honor for "his continued interest in and contribution to the application of the fluidized technique for solids handling and his interest in the problems and development of technical employes."

Stone & Webster Veteran Retires; Two Appointed

Charles A. Bigelow, San Francisco, vice president and director of Stone & Webster Engineering Corporation, after 22 years as West Coast district manager and more than 45 years with the S & W organization, has retired. N. M. Floyd has assumed the management of the company's San Francisco office and W. L. Sheets at the same time became the manager of the Los Angeles office.

Sheets has also been named general superintendent of the Western Area for Stone & Webster.

Felt to Retire March 1

Twenty-five years to the day after he joined Warren Petroleum Corporation, Howard E. Felt, vice president of the corporation in charge of its LPG Marketing division, will retire.

In order to facilitate changes in the Warren organization which will result from his retirement, Felt first submitted his resignation effective January. He will now remain a director of the company and will remain active in the management of the division until March 1. Thereafter he will be available for consultation and special assignment duties.

G. L. Brennan, manager of the LP-Gas division for the past 12 years, has been elected vice president of the division to succeed Felt.

Promoted to manager of the division, succeeding Brennan, was Fred S. Schwend, assistant manager of supplies. K. T. White, for several years head of the division's district office at Houston,

PSC furnishes 300 styles of BUBBLE CAPS and RISERS in Any Metal

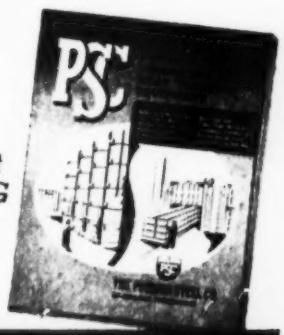
- **ALUMINUM**
- **BRASS**
- **COPPER**
- **NICKEL**
- **STAINLESS STEEL,** any chrome-nickel or straight chrome type
- **STEEL,** carbon

...and Without Die Cost

Being entirely unassociated with any metal producer, PSC regularly fabricates the complete list of ferrous and non-ferrous metals and alloys normally available today. At PSC you can order processing equipment in the one particular metal which best meets your specific heat and corrosion requirements. Service records of fractionating towers, for instance, show that this PSC advantage repeatedly results in better life/cost ratios of bubble caps. Quotations on alternate metals are always available at PSC.

With dies on hand for about 300 standard styles of bubble caps and risers, PSC is in a position not only to save many customers the cost of dies but also to save them design and delivery time. PSC bubble caps are furnished for all methods of tray assembly. Special caps furnished to order. Send blue prints or write as to your needs. You will find, we believe, the largest compilation of engineering data on bubble caps and risers in PSC catalog 52.

Send for Process Equipment CATALOG 52



THE PRESSED STEEL COMPANY
of WILKES-BARRE, PENNSYLVANIA

Industrial Equipment of Heat and Corrosion Resistant WEIGHT-SAVING *Sheet Alloys*

☆ ☆ ☆ OFFICES IN PRINCIPAL CITIES ☆ ☆ ☆

What's Happening. . .

has been made sales manager of the division.

Bid for Surplus Plant Omits Synthetics Unit

American Cyanamid Company's offer to lease for six years the anhydrous ammonia plant which is on the same tract as the synthetic liquid fuels demonstration plant at Louisiana, Mo., has been approved. American Cyanamid's lease included an option to purchase the installation during the first three years.

The lease, however, does not cover either the synthetics fuel plant or land on which it stands, leaving disposal of the facilities still much up in the air.

Texaco Appoints Dawson Manager of Purchasing

Frank M. Dawson, who has been with The Texas Company and associated companies for the past 25 years, has been named manager of Texaco's Purchasing department.

Dawson joined The Texas Company in 1928 and, since 1946, has been vice president and later executive vice president and director of Carthage-Hydrocol, Inc.

He began his service with Texaco as a chemist at the Port Arthur, Texas, Works in 1928. In 1942, he became superintendent of the refinery of an associated company in Buenos Aires, Argentina. Three years later he was named superintendent of the Lawrenceville, Ill., Works.

Shell Chemical Forms New Ammonia Division

A new Ammonia division has been established by Shell Chemical Company

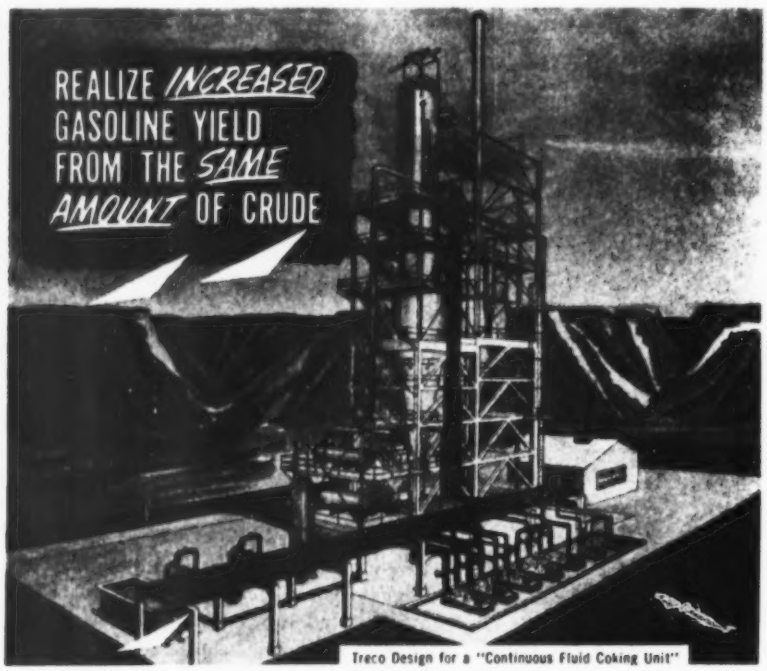
Roberts

Monkhouse

to handle the manufacture, distribution and sale of the chemical. Headquarters of the new division are at San Francisco, Calif. Its formation follows the recent opening of the new Shell Chemical ammonia plant at Ventura, Calif.

G. R. Monkhouse, vice president of Shell Chemical, has been appointed head of the division. L. M. Roberts, general manager of manufacturing in the company's New York headquarters, has become the new division's operations manager in charge of manufacturing, distribution and marketing engineering. Roberts will also have direct charge of the company's two ammonia plants, the pioneer Pittsburg, Calif., plant and the Ventura plant. V. C. Irvine has been designated sales manager of the Ammonia division.

In addition to their new duties, Monkhouse and Irvine will continue as manager and sales manager, respectively, of Shell Chemical's Western division.



Treco Design for a "Continuous Fluid Coking Unit"

FLUID COKING

Increased gasoline yield from the same amount of crude, with more profits to the refiner, is but one result of "Continuous Fluid Coking"; a new process for coking heavy residual fuels developed by Standard Oil Development Company and offered to you by TRECO.

TRECO is approved by Standard Oil Development Company to engineer and construct "Continuous Fluid Coking" units. Telephone, wire or write for complete information on how this valuable new process can fit into your operations.

TRECO
REFINERY ENGINEERING Company
TULSA, OKLAHOMA TORONTO, ONTARIO

CHEMICALS WANTED

The National Registry of Rare Chemicals, Armour Research Foundation, 33rd, Federal and Dearborn Streets, Chicago 16, has received urgent requests for the chemicals listed below. If anyone has one or more, even if only one gram quantities, please inform the Registry.

Barium persulfate
3,3,3-Trifluoropropene
3,3,3-Triiodopropene
Cyclobutanone
Cyclopentyl amine
3-Methylquinoline
1,7-Dichloronaphthalene
Dihydroquercetin
Phenylaluminum dichloride
Epicyanohydrin
para-Quinquephenyl
3-Cyanopyrene
Retene
Pyrimidine
Tetrahydrophenanthrene
1,3,5-Trimethylolbenzene
3-Chloro-1-butanol
Diethyl sulfone

Bradstreet, Miller Join American Development

American Development Corporation, New York, has added Raymond B. Bradstreet and Ralph Miller to its staff. Bradstreet, recently of Bradstreet Laboratories, Inc., and for many years with

"We had to make certain about desalting—

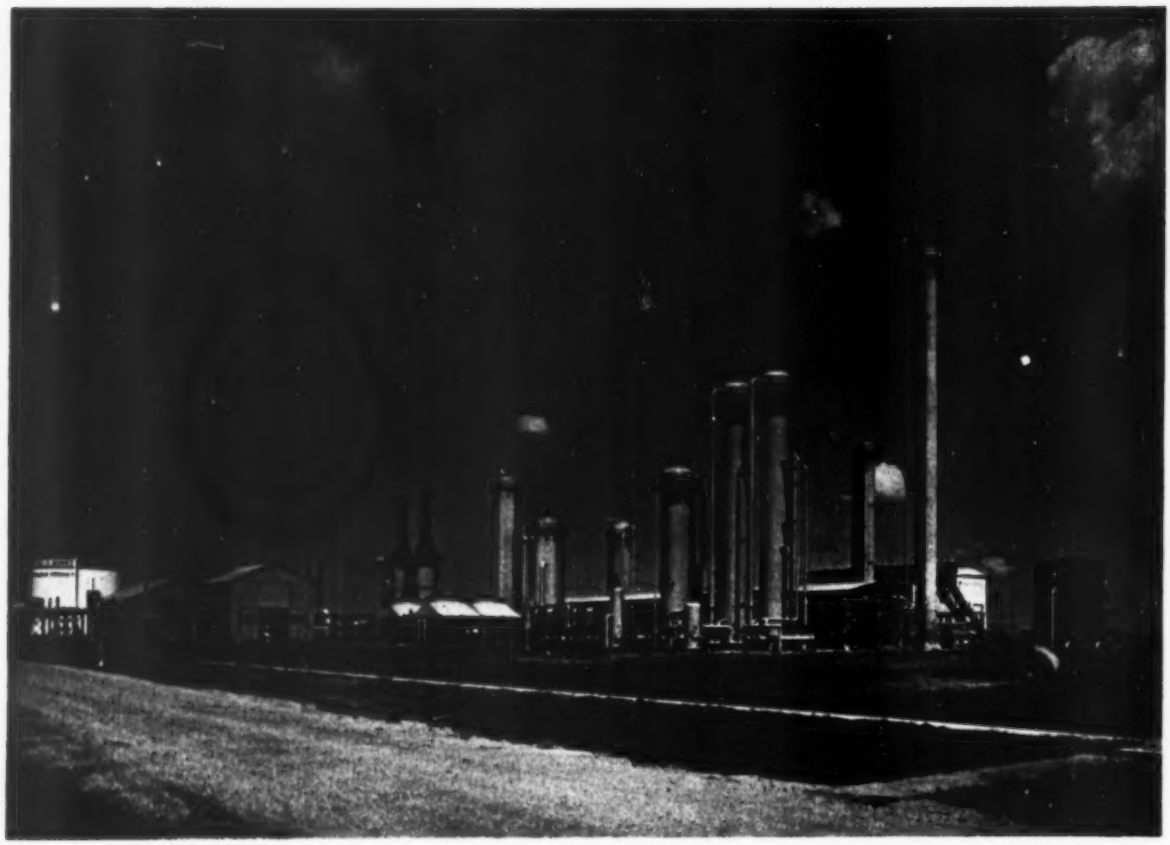
so we called Howe-Baker"

Refiners throughout the world consult Howe-Baker about emulsion problems. In fact, on 3 continents more than 1,000,000 barrels of crude oil per day are being treated by custom built electrostatic units designed by Howe-Baker. Call us for a detailed discussion of your particular requirements.

SPECIALISTS IN PETROLEUM EMULSIONS

THE HOWE BAKER CORP.

ESPERSON BUILDING • HOUSTON 2, TEXAS



The NEW *Ambrose Gasoline Plant*

at Blackwell, Oklahoma Processes Gas From the Cross Country Pipe Line of Cities Service Gas Company

Through the operation of this plant, designed to produce daily over 4500 barrels of fractionated liquid products from pipe line gas, another completely satisfied plant owner, CITIES-BLACKWELL CORPORATION, is added to the long list of oil and gas companies entrusting such multi-million dollar projects to *HUDSON*, experienced in 20 years of designing and building gas processing plants.

The HUDSON organization, qualified by years of experience in the successful design, construction and operation of major oil and gas processing plants, offers its specialized services for projects in any part of the world.

HUDSON
ENGINEERING CORPORATION
FAIRVIEW STATION • HOUSTON, TEXAS

What's Happening. . .

Standard Oil Company (New Jersey) affiliates, will serve as technologist. Miller, who for many years has been with the Chemical Foundation as director of research, will devote his time to research and development work in the petroleum and chemical fields.

Constructors Association Elects Officers for 1954

John F. O'Connell, vice president of Bechtel Corporation, has been elected president of the National Constructors Association.

J. H. Sharpe, construction manager for Arthur G. McKee & Company was elected vice president at the association's annual meeting held recently in New York.

Other members of the executive committee include: E. R. McGonnigle, The M. W. Kellogg Company; C. C. Whittelsey, Ford, Bacon & Davis Construction Corporation; T. C. Williams, Stone & Webster Engineering Corporation; W. R. Wood, The Girdler Company; and L. C. Reynolds, C. F. Braun & Company.

Other chairmen elected for 1954 were: P. S. Klick, Jr., Foster Wheeler Corporation, chairman of the Labor Committee; B. O. Yeldell, Ford, Bacon & Davis, co-chairman; F. R. Stevens, Stone & Webster, co-chairman; J. J. Kelly, Kellogg, chairman of the Safety Committee; H. B. Christman, The Fluor Corporation, Ltd., chairman of the Foreign Committee; and E. D. Hoekstra, The H. K. Ferguson Company, Inc., chairman of the Public Affairs Committee.

Conoco Adds Tung and Gant To Development-Research

Shao E. Tung and Preston L. Gant have joined Continental Oil Company's Development and Research department staff in Ponca City, Okla.

Tung, born in Chekiang, China, has completed studies for his doctor's degree in chemical engineering from the Massachusetts Institute of Technology. He was formerly a chemist with a paper mill in Shanghai and later superintendent of a paper and pulp mill in Formosa.

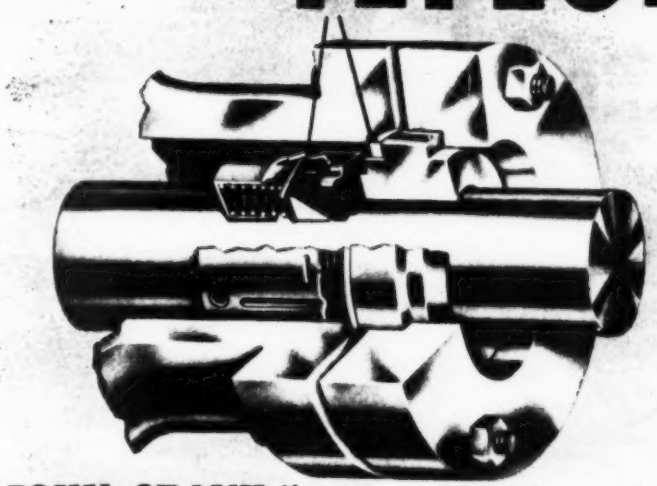
Gant has been associated with the Magcobar Mud Company, Houston, since 1952.

Mares Leaves Monsanto After 25-Year Service

Joseph R. Mares, vice president of Monsanto Chemical Company since 1949, has left that company after 25 years of service. His plans are not definite yet, Mares said, but he is considering engaging in consulting chemical and engineering practice in Houston.

For the past seven years Mares has been general manager of Monsanto's Texas division in Texas City, Texas. Under a recent merger of the Texas division with the Plastic division in Springfield, Mass., Mares had been scheduled to head a new division.

NOW—A SHAFT SEAL THAT WITHSTANDS ANY CHEMICAL.....Designed WITH * TEFLON



"JOHN CRANE" TYPE 9 Mechanical Seal

Prevents Leakage of:

- √ EXPENSIVE CHEMICALS
- √ INFLAMMABLE LIQUIDS
- √ TOXIC GASES
- √ CORROSIVE LIQUIDS
- √ SOLVENTS

Other John Crane Teflon Products include expansion joints, C-V Rings, packings and gaskets. Also, parts molded or machined to your particular requirements.

This revolutionary seal was developed by Crane Packing Company after two years research and field testing—expressly for use with hard-to-handle chemicals. Its flexible wedge ring and sealing ring are molded from the remarkable new plastic, Teflon, which is not affected under any known corrosive or solvent service.

John Crane engineers thus put the unique properties of Teflon—high heat resistance, extremely low friction and chemical inertness—to practical use in the Type 9 Seal. Result: a new, efficient way to handle corrosive liquids and gases that never before could be effectively controlled by conventional, flexible-type mechanical seals. It can be employed at temperatures up to 500°F.

The Type 9 Seal gives consistently dependable service on all rotating shaft applications, such as centrifugal pumps, turbines, speed reducers, positive displacement pumps and agitators

Write today for new booklet describing the "John Crane" Type 9 Shaft Seal—
CRANE PACKING COMPANY, 1820 Cuyler Ave., Chicago 13, Illinois

**DuPont's trademark for tetrafluoroethylene resin*

JOHN CRANE CRANE PACKING COMPANY

PETROLEUM

Your interest in **REFINER**

makes this a logical place to tell you about . . .

BALDWIN-HILL

No. 1 INSULATIN[G] CEME[NT]

Where you require a highly effective, plastic insulation to be applied easily and economically . . . B-H No. 1 CEMENT is your answer. It is particularly adaptable for insulating ducts, breechings, valves and piping not suited to molded types of insulation. Effective up to 1800°F., B-H No. 1 has exceptionally low thermal conductivity. It also provides an economical advantage in its reclaimability where temperatures have not exceeded 1200°F. It can be remixed with water and used again without loss of efficiency. And a rust inhibitor prevents corrosion of steel surfaces covered by B-H No. 1 CEMENT. For more complete information, get in touch with B-H Engineered Insulation Service—and send the coupon below.

Baldwin-Hill

Clip on signed letterhead and mail

TEAR OUT

BALDWIN-HILL COMPANY, 702 Breunig Ave., Trenton 2, N. J.

Please send complete information on

- ☐ **No. 1 INSULATING CEMENT . . . All purpose, rust-inhibiting, plastic cement**
- ☐ **MONO-BLOCK . . . Rigid, felted rockwool block—for high and low temperature use**
- ☐ **POWERHOUSE CEMENT . . . High adhesion, rockwool, insulating-finishing cement**
- ☐ **BLANKETS . . . Metal reinforced, flexible, felted, rockwool insulation**

Meet Our Authors . . .

Continued from Page 164

different assignments. Among them: equilibrium studies on crude oil and distillates, hydrofluoric acid alkylation research and the development of low temperature fractional distillation techniques.

Dinneen Works With Shale Oil Composition

G. U. Dinneen, "Shale Oil—What Is It?", page 113.

Since 1950 this Bureau of Mines chemist has been a leader of a unit concerned with the composition of shale oil and distillates from it. His work at the Bureau's Petroleum and Oil-Shale Experiment Station, Laramie, Wyo., has involved both detailed characterization studies and development of suitable analytical techniques. Dinneen's principal outside technical activity during that time has been in the Wyoming Section of ACS, of which he has been chairman.

Walter Educated at Four Different Schools

John T. Walter, "Statistical Quality Control," page 149.

A native of Pennsylvania, John Walter was educated at Drexel Institute of Technology, Columbia University, New York University and the University of Pittsburgh. A management consultant, Dr. Walter has been on the faculty of the School of Business Administration, University of Pittsburgh, since 1947. He recently returned to the school after completing a one year assignment with Esso Standard Oil Company.

Fletcher's Work Leads Concern Into New Field

George R. Fletcher, "Gas Jet Compressors," page 107.

Several years after receiving a B.S. degree in chemical engineering from New York University, George R. Fletcher joined Worthing Corporation as designer of steam condensers. His work in the design of steam jet ejectors and research on the use of high-pressure natural gas and propane, begun in 1946, has resulted in Worthington's entry into this field.

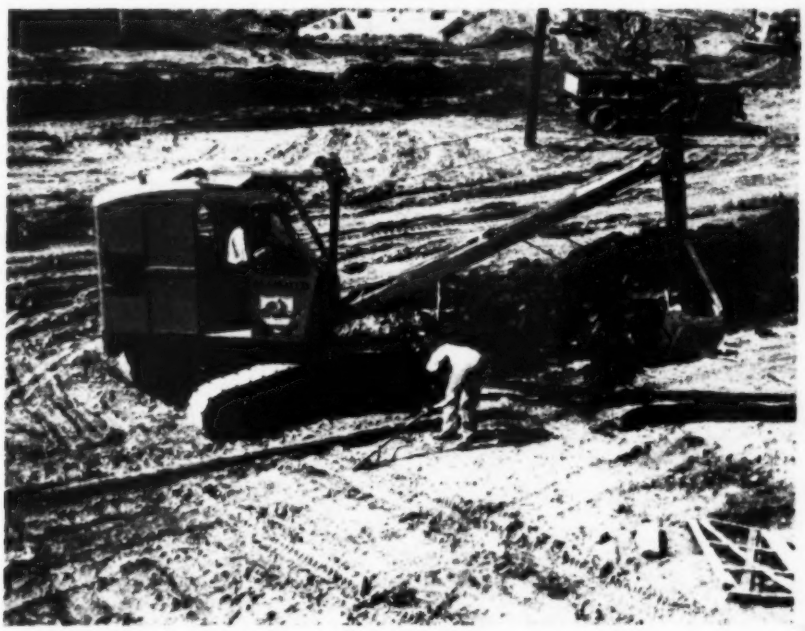
Browning Shows Profit In Chemical Cleaning

J. T. Browning, "How Chemical Cleaning Makes Money," page 131.

This area engineer for Dowell Incorporated, Chicago, was born at Verona, Mo., and received his B.S. degree from Central State College, Edmond, Okla. Before joining Dowell he was associated with Petrolite Corporation, and Skelly Oil Company.

Browning joined Dowell in 1944 at Salem, Ill., as industrial engineer, advancing to station manager at Chicago Heights that same year. In 1946 he became development engineer at Chicago and was promoted to area engineer in 1952.

Here's how a SCHIELD Bantam® can cut your Lifting and Trenching Jobs in '54!



Truck Mounted Bantam does all kinds of lifting jobs. Versatile Bantam moves from siding to siding at truck speeds, keeping crew tie-ups to a minimum . . . works in all kinds of weather with ease. Eliminates extra men and machines on scattered jobs.

Crawler Bantam . . stays on the job in all kinds of weather . . . is ideal for trenching or repair where poor underfoot conditions call for low ground bearing pressures. (As low as 2½ psi with 32" pads)

A Schield Bantam is the most profitable answer to your problems!

Give your operating budget a break! Your Bantam, Crawler or truck-mounted, has no seasonal slow-ups . . . goes anywhere to do a wide variety of lifting and digging jobs . . . then handles these jobs faster . . . at less cost.

Here's What You Get!

When you invest in a Bantam, you get rugged, simple design. It's a machine that averages less than $100 a year for parts and maintenance (truck mounted). It's a low cost machine with these features normally found ONLY on larger, more expensive rigs: 10,000 lb. (Crawler) or 12,000 lb. (Truck Mounted) lifting capacities; Full circle swing for tight quarter operation, Standard equipped with Power Boom Hoist; An all-purpose rig that will dig 100′ of 5′ ditch per hour (with a maximum digging depth of 16′): Quick to reach, fast acting, easy-to-maintain mechanical controls; Complete versatility with 9 fast-change front-end attachments allowing quick adaptation to jobs needing a back hoe, crane, clamshell, backfiller, dragline, shovel, magnet, grapple or pile driver. ONE Bantam does all these jobs . . . saving your equipment budget.

NOW is the time to see these rigs ON YOUR JOBS! A free demonstration is yours for the asking . . . without obligation. See for yourself how the Bantam can do your jobs cheaper . . . faster. Write today!

A SCHIELD Bantam®

DOES ALL THESE JOBS FASTER . . . . CHEAPER!

- ★ **Unloading pipe at scattered sidings.**
- ★ **Reloading pipe for haul to spread.**
- ★ **Digging bell holes.**
- ★ **Excavating for leak repairs.**
- ★ **Spotting fittings accurately.**
- ★ **Cleaning out sides.**
- ★ **Uncovering line sections for inspections.**
- ★ **Backfilling trench.**

SB-TMCR-1

SCHIELD Bantam

COMPANY • 285 PARK ST., WAVERLY, IOWA, U.S.A.

WORLD'S LARGEST PRODUCERS OF TRUCK-CRANES AND EXCAVATORS

Here's the mailing card key to get more

Information on Advertised Products

SAVE TIME . . .

By using the free and convenient Reader Service Postcards on opposite page. Circle on the card the identifying key number listed below for each advertisement in this issue on which additional data are desired.

IT'S FAST, CONVENIENT, CERTAIN

A

(A1) The Air Preheater Corp. 44
(A2) Air Reduction Magnolia Co. ..... Opp. 229
(A3) Airetool Manufacturing Co. 202
(A4) Allis-Chalmers Manufacturing Co. 28-29
(A5) Allis-Chalmers Manufacturing Co. 31
(A6) Aluminum Company of America 234-235
(A7) American Brass Co. 20
(A8) American Cyanamid Co. 53
(A9) American District Steam Co. 62
(A10) American Locomotive Co. 76-77
(B1) American Sand-Banum Co. 252
(B2) Appleton Electric Co. 170-171
(B3) Atlas Powder Co. 35

B

(B4) The Babcock & Wilcox Co. 36-37
(B5) Badger Manufacturing Co. 85
(B6) Bailey Meter Co. 33
(B7) Baldwin-Hill Co. 194
(B8) The J. B. Beaird Co. ..... Opp. 32
(B9) The J. B. Beaird Co. ..... Opp. 33
(B10) Beaumont Forging Co. 236
(C1) Bethlehem Steel Co. 79
(C2) Black, Sivalls & Bryson, Inc. 57
(C3) Blaw-Knox Co. 184
(C4) Bonney Forge & Tool Works 34
(C5) Bridgeport Brass Co. 219
(C6) The Bristol Co. 8
(C7) Brown & Root, Inc. 216
(C8) Buell Engineering Co. 65

C

(C9) Catalytic Construction Co. 28
(C10) Catawissa Valve & Fittings Co. 250
(D1) Central Scientific Co. 32
(D2) The Chapman Valve Manufacturing Co. 42
(D3) Chase Brass & Copper Co. 182
(D4) Chemical Construction Corp. 66
(D5) Chicago-Wilcox Mfg. Co. 252
(D6) Clark Bros. Co. 48-49
(D7) Cleton Ltd. 180
(D8) The J. S. Coffin, Jr., Co. 183
(D9) Conoflow Corp. 22
(D10) The Cooper-Bessemer Corp. 174-175
(E1) Corning Glass Works 218
(E2) Crane Company 165
(E3) Crane Packing Co. 193
(E4) Croll-Reynolds Co. 209
(E5) Crouse-Hinds Co. 50

D

(E6) Dean Brothers Pumps Inc. 188
(E7) De Laval Steam Turbine Co. 207
(E8) Dempster Brothers 71
(E9) John Dollinger, Jr., Inc. 255
(E10) Dowell Incorporated 215
(F1) Draco Corp. 209
(F2) E. I. du Pont de Nemours & Co. Insert 64-65
(F3) E. I. du Pont de Nemours & Co. 90
(F4) The Duralov Co. 206

E

(F5) Eastman Chemical Products, Inc. 54
(F6) Electro-Snap Switch & Mfg. Co. 209
(F7) Elliott Company 161
(F8) Enjay Company, Inc. 63

F

(F9) Farris Engineering Corp. 12-13
(F10) Fenwal Inc. 74
(G1) Fisher Governor Co. 47
(G2) Flexonics Corp. 168
(G3) The Fluor Corp. 19
(G4) Foster Engineering Co. 180
(G5) Foster Wheeler Corp. 41
(G6) The Foxboro Co. 14

G

(G7) General American Transportation Corp. 83
(G8) General Electric Co. 68-69
(G9) The Girdler Company 229
(G10) Claud S. Gordon Co. 226
(H1) Graver Tank & Mfg. Co. ..... III Cover
(H2) Grinnell Company 10
(H3) Gulf Publishing Co. 231
(H4) Gulf States Asphalt Co. 224
(H5) Gunite Concrete & Construction Co. 256

H

(H6) Hartzell Propeller Fan Co. 260
(H7) The Howe-Baker Corp. ..... Opp. 192
(H8) Hudson Engineering Corp. ..... Opp. 193

I

(H9) Ingersoll-Rand Co. 7
(H10) The International Nickel Co. 177

J

(J1) The C. O. Jelliff Mfg. Corp. 252
(J2) Jet-Lube, Inc. 252
(J3) Jones & Laughlin Steel Corp.
Supply Division 70

K

(J4) Keasbey & Mattison Co. 81
(J5) Wm. Kenyon & Sons, Ltd. 238
(J6) The Key Co. 186
(J7) Kilbourn Engineering Co. 214
(J8) Kinney Mfg. Division
The New York Air Brake Co. 208
(J9) Koppers Co. 198

L

(J10) Layne & Bowler, Inc. 25
(K1) Warner Lewis Co. 225
(K2) Lubbock Machine & Supply Co. 249
(K3) Lukens Steel Co. 38
(K4) The Lummus Co. 212
(K5) The Lummus Co. 239

M

(K7) Manning, Maxwell & Moore, Inc. 52
(K8) Mason-Neilan Regulator Co. 16
(K9) The Master Electric Co. 39
(K10) A. Y. McDonald Mfg. Co. ..... IV Cover
(L1) Arthur G. McKee & Co. 167
(L2) Metal Goods Corp. 64
(L3) Midwest Piping Co., Inc. 40
(L4) Minneapolis-Honeywell Regulator Co. 72-73
(L5) Mixing Equipment Co. 88
(L6) Samuel Moore & Co. 201
(L7) Murray Iron Works Co. 176

N

(L8) National Airoil Burner Co. 226
(L9) National Tube Division
United States Steel Corp. 86
(L10) Newport News Shipbuilding & Dry Dock Co. 181
(M1) W. H. Nicholson & Co. 4
(M2) Nitrogen Division
Allied Chemical & Dye Corp. 11
(M3) Nooter Corp. 84
(M4) Norton Co. 18

O

(M5) Oakite Products, Inc. 242
(M6) Oil Well Supply Division
United States Steel Corp. 9
(M7) Orbit Valve Co. 173

P

(M8) Pacific Pumps, Inc. 221
(M9) Pacific Tube Co. 5
(M10) Palmer Thermometers, Inc. 218
(N1) The Ralph M. Parsons Co. 241
(N2) The Patterson Foundry & Machine Co. 205
(N3) Peerless Pump Division
Food Machinery & Chemical Corp. 17
(N4) Pemberton Injector Co. 56
(N5) Perco Division
Phillips Petroleum Co. 204
(N6) Petro-Chem Development Co. 211
(N7) Petroleum Electric Power Assoc. 45
(N8) Petroleum Refiner 225, 246
(N9) Petrolite Corp. 55
(N10) Philadelphia Gear Works, Inc. 23
(P1) Pittsburgh Corning Corp. 43
(P2) The Wm. Powell Co. 46
(P3) The Pressed Steel Co. 191
(P4) J. F. Pritchard & Co. 27
(P5) J. F. Pritchard & Co. 237

Q

(P6) The Quaker Oats Co. 185

R

(P7) Read Standard Corp. 190
(P8) The Refinery Catalog 84
(P9) The Refinery Engineering Co. 192
(P10) Republic Steel Corp. 26
(Q1) Republic Steel Corp. 223
(Q2) Revere Copper and Brass Inc. 161
(Q3) The Ridge Tool Co. 200
(Q4) Rockwell Manufacturing Co. 60-61
(Q5) Rockwood Sprinkler Co. 24
(Q6) Rockwood Sprinkler Co. 203

S

(Q7) Sarco Company, Inc. 75
(Q8) Schield Bantam Company 195
(Q9) Sealol Corporation 169
(Q10) Service Foundry
Division Avondale Marine Ways, Inc. 251
(R1) The Sherwin-Williams Co. 87
(R2) Southern Engine & Pump Co. 253
(R3) Sparkler Manufacturing Co. 187
(R4) Standard Steel Spring Division
Rockwell Spring & Axle Co. 255
(R5) Stauffer Chemical Co. 230
(R6) Stone & Webster Engineering Corp. Opp. 228
(R7) Struthers Wells Corporation 67
(R8) Sun Shipbuilding & Dry Dock Co. 227

T

(R9) Taylor Instrument Companies 58-59
(R10) Tennessee Corporation 244
(S1) The Terry Steam Turbine Co. 220
(S2) Texas Pipe Bending Co. 15
(S3) Thermo Electric Co. 172
(S4) The Timken Roller Bearing Co. 6

U

(S5) United States Rubber Co. 243
(S6) Universal Atlas Cement Co. 250

V

(S7) Vernon Tool Co., Ltd. 249
(S8) Henry Vogt Machine Co. 247
(S9) J. H. H. Voss Company 214

W

(S10) Wagner Electric Corp. 80
(T1) Walworth Company 82
(T2) Warren Petroleum Corp. 233
(T3) Watson-Stillman Fittings Division
H. K. Porter Company 245
(T4) Western Supply Co. 51
(T5) Weston Electrical Instrument Corp. 199
(T6) Whitlock Manufacturing Co. 189
(T7) The Gustav Wiedeke Co. 222
(T8) Wolverine Tube Division
Calumet & Hecla, Inc. 179
(T9) Worthington Corp. 21

Y

(T10) Yarnall-Waring Company ..... II Cover
(U1) Otto H. York Co., Inc. 228

The Handy Postcards → Get Quick Action

What's New in Manufacturers' Literature

For copies of the catalogs and new equipment literature listed, use one of the convenient Reader Service Postcards on this page. Just circle the number on the card corresponding to the number of the item in which you are interested.

Leaf Filter Catalog

Niagara Filters Division of American Machine and Metals Corporation has published a new catalog on the complete line of Niagara filters. This new 20-page brochure is fully illustrated with photographs, diagrams, and charts on the design and operation of pressure-leaf filters. It includes complete information on the new type "H" filter recently introduced by the company. Data on sizes, capacities and dimensions for both vertical and horizontal filters are listed. Services available from Niagara, including laboratory, pilot plant rental, custom engineering and installation, and start-up services, are discussed. Get your copy of this bulletin now. Just . . .

Circle No. 1 on Postcard

Teflon Bulletin

A third revision of a Du Pont technical bulletin on Teflon resin finishes is now being made available by E. I. du Pont de Nemours & Company. The 12-page booklet lists some 17 successful new applications in addition to those reported in the earlier edition. All of the new uses are derived from the notable release property of Teflon, its high corrosion and heat resistance, as well as its low coefficient of friction. Also discussed in the bulletin are various finishing systems of Teflon primers and enamels over metallic and non-metallic surfaces. To get your copy of this new bulletin, just . . .

Circle No. 2 on Postcard

USE THESE CARDS
To Get
COPIES OF CATALOGS
And for More
Information on
NEW EQUIPMENT
ADVERTISED PRODUCTS

EASY TO USE

Circle on one of the cards at right the identifying numbers of each new equipment and catalog item or advertised product on which you want more information. Print your name and address plainly. Tear out and mail card. That's all there is to it. No postage is required if card is mailed in U.S.A. Your request will be forwarded promptly to the company concerned, and the reply will come direct to you.

Controlled-Volume Pumps

A new 16-page bulletin on air powered controlled volume pumps has just been made available to the refining and petrochemical industries by Milton Roy Company. This new bulletin shows how these pumps are used to solve low capacity flow problems. It contains a graphic presentation of pump operating principles, capacity-pressure and air consumption tables and examples of complete chemical feed systems using these "instruments." For your copy of this informative bulletin, just . . .

Circle No. 3 on Postcard

Instrument Bulletin

Just released, a new 12-page bulletin published by Central Scientific Company is an excellent guide for the selection of electronic and electrical measuring instruments and accessories for industrial and laboratory requirements. Among the wide variety of instruments illustrated and described are electronic electrometers, electronic relays, audio frequency oscillators, bridges, potentiometers, frequency meters, resistance standards and oscilloscopes. Your copy is available now. Just . . .

Circle No. 4 on Postcard

Postage Will be Paid by Gulf Publishing Company

No Postage Stamp Necessary if Mailed in the United States

BUSINESS REPLY CARD

First Class Permit No. 7 (Sec. 34.9, P. L. & R.), Houston, Texas

PETROLEUM
REFINER

BOX 2608

HOUSTON 1, TEXAS, U. S. A.

PETROLEUM REFINER Reader Service Postcard—Feb., 1954, Issue*

EDITORIAL ITEMS—Circle item numbers on which more information desired:

1	3	5	7	9	11	13	15	17	19	21	23	25
2	4	6	8	10	12	14	16	18	20	22	24	26

ADVERTISEMENTS—Circle key number of ad for more product information:

A1	B1	C1	D1	E1	F1	G1	H1	J1	K1	L1	M1	N1	P1	Q1	R1	S1	T1	U1
A2	B2	C2	D2	E2	F2	G2	H2	J2	K2	L2	M2	N2	P2	Q2	R2	S2	T2	U2
A3	B3	C3	D3	E3	F3	G3	H3	J3	K3	L3	M3	N3	P3	Q3	R3	S3	T3	U3
A4	B4	C4	D4	E4	F4	G4	H4	J4	K4	L4	M4	N4	P4	Q4	R4	S4	T4	U4
A5	B5	C5	D5	E5	F5	G5	H5	J5	K5	L5	M5	N5	P5	Q5	R5	S5	T5	U5
A6	B6	C6	D6	E6	F6	G6	H6	J6	K6	L6	M6	N6	P6	Q6	R6	S6	T6	U6
A7	B7	C7	D7	E7	F7	G7	H7	J7	K7	L7	M7	N7	P7	Q7	R7	S7	T7	U7
A8	B8	C8	D8	E8	F8	G8	H8	J8	K8	L8	M8	N8	P8	Q8	R8	S8	T8	U8
A9	B9	C9	D9	E9	F9	G9	H9	J9	K9	L9	M9	N9	P9	Q9	R9	S9	T9	U9
A10	B10	C10	D10	E10	F10	G10	H10	J10	K10	L10	M10	N10	P10	Q10	R10	S10	T10	U10

Name (Please Print)_____

Company_____ Position_____

Address_____

MAIL IT NOW . . . *CARD EXPIRES MAY 10, 1954

What's New in Manufacturers' Literature

Use one of the free and convenient Reader Service Postcards on this page to request copies of the catalogs in which you are interested.

Metal Hose Catalog

A 32-page illustrated catalog on all types of Flexon metal hose has just been released by Flexonics Corporation. This catalog covers the full range of the company's manufacture in corrugated metal hose, convoluted hose types, stainless steel flexible metal hose, and numerous special purpose assemblies. In addition to the complete listings in this catalog, a large amount of technical data such as minimum recommended bend diameter, burst pressure, and weight per foot are given. Installation information and coupling types are also covered in this new catalog. To get your copy, just . . .

Circle No. 5 on Postcard

Refrigeration Data

Henry Vogt Machine Company is now offering a new bulletin covering its complete line of refrigeration condensers. This 40-page booklet covers such topics as "How to Select the Proper Condenser," a general description of condenser-towers, a saturated ammonia temperature table, a saturated Freon-12 temperature table, pipe sizes for both ammonia and Freon lines, and many tables of specifications of both ammonia and Freon refrigeration condensers. To get this informative bulletin, simply . . .

Circle No. 6 on Postcard

Fan Data Book

A new bulletin, "Fan Engineering Data," has just been issued by Hartzell Propeller Fan Company. Among the valuable ventilation engineering information selected by Hartzell engineers for inclusion in this 16-page booklet are fan laws and formulae, terms and definitions, recommended velocities for exhaust hoods, an air pressure conversion table, and charts covering duct resistance, entrance losses and rectangular equivalents of round ducts. Other sections discuss fan installations, maintenance and lubrication, noise problems, and the characteristics of various propeller and wheel designs. To get your copy, simply . . .

Circle No. 7 on Postcard

Fire Pump Bulletin

A new bulletin on vertical turbine fire pumps is being offered by Worthington Corporation. This bulletin describes pumps which are designed to provide constant protection against fire in industrial installations. In addition to description, specifications covering capacities, pressures, motor hp, rpm and dimensional drawings are also included. For your copy, simply . . .

Circle No. 8 on Postcard

Recording Charts

A complete new catalog covering thousands of recording charts is now available from American Recording Chart Company. This 30-page, well illustrated catalog, lists charts for practically every leading make of recording instrument. To get your copy, just . . .

Circle No. 9 on Postcard

Products Catalog

Johns-Manville has issued a new 40-page catalog of industrial products which offers essential engineering data on the following: insulation, refractory products, asbestos cement pipe, packings, gaskets, electrical products, roofing, siding, flooring and frictional materials. Get your copy now. Just . . .

Circle No. 10 on Postcard

PETROLEUM REFINER Reader Service Postcard—Feb., 1954, Issue*

EDITORIAL ITEMS—Circle item numbers on which more information desired:

1	3	5	7	9	11	13	15	17	19	21	23	25
2	4	6	8	10	12	14	16	18	20	22	24	26

ADVERTISEMENTS—Circle key number of ad for more product information:

A1	B1	C1	D1	E1	F1	G1	H1	J1	K1	L1	M1	N1	P1	Q1	R1	S1	T1	U1
A2	B2	C2	D2	E2	F2	G2	H2	J2	K2	L2	M2	N2	P2	Q2	R2	S2	T2	U2
A3	B3	C3	D3	E3	F3	G3	H3	J3	K3	L3	M3	N3	P3	Q3	R3	S3	T3	U3
A4	B4	C4	D4	E4	F4	G4	H4	J4	K4	L4	M4	N4	P4	Q4	R4	S4	T4	U4
A5	B5	C5	D5	E5	F5	G5	H5	J5	K5	L5	M5	N5	P5	Q5	R5	S5	T5	U5
A6	B6	C6	D6	E6	F6	G6	H6	J6	K6	L6	M6	N6	P6	Q6	R6	S6	T6	U6
A7	B7	C7	D7	E7	F7	G7	H7	J7	K7	L7	M7	N7	P7	Q7	R7	S7	T7	U7
A8	B8	C8	D8	E8	F8	G8	H8	J8	K8	L8	M8	N8	P8	Q8	R8	S8	T8	U8
A9	B9	C9	D9	E9	F9	G9	H9	J9	K9	L9	M9	N9	P9	Q9	R9	S9	T9	U9
A10	B10	C10	D10	E10	F10	G10	H10	J10	K10	L10	M10	H10	P10	Q10	R10	S10	T10	U10

Name (Please Print)_____

Company_____ Position_____

Address_____

MAIL IT NOW . . . *CARD EXPIRES MAY 10, 1954

Postage Will be Paid by Gulf Publishing Company

No Postage Stamp Necessary if Mailed in the United States

BUSINESS REPLY CARD

First Class Permit No. 7 (Sec. 34.9, P. L. & R.), Houston, Texas

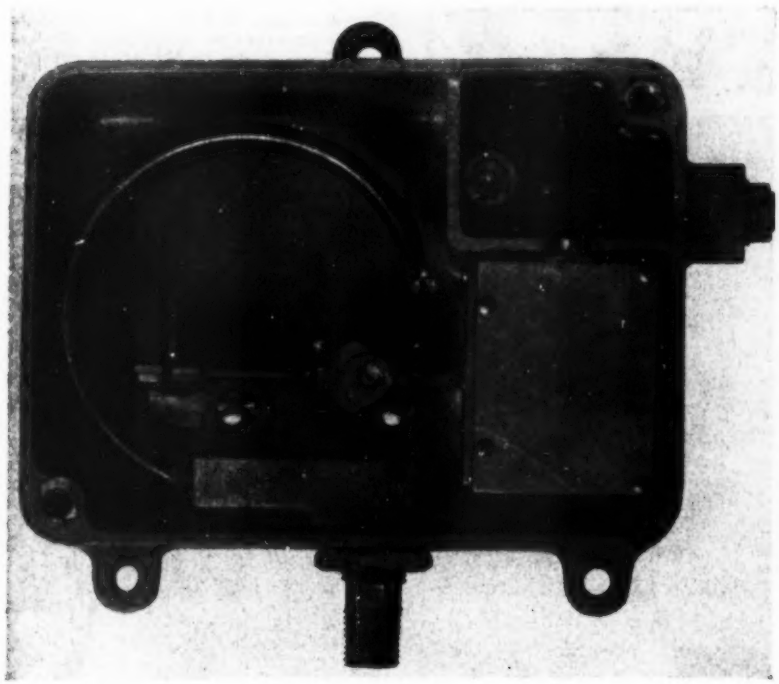
PETROLEUM
REFINER

BOX 2608

HOUSTON 1, TEXAS, U. S. A.

USE THESE CARDS
To Get
COPIES OF CATALOGS
And for More
Information on
— NEW EQUIPMENT
ADVERTISED PRODUCTS

What's New In Equipment . . .



Sensitive Transducer

For remote position instrumentation that features high accuracy.

A new transducer, the Dynaformer pressure cell, has been introduced by The Foxboro Company. This highly sensitive new element converts fluid pressure into a proportional ac voltage which is measured in terms of pressure by an electronic resistance Dynalog instrument.

Basically, the Dynaformer cell consists of a Bourdon pressure spring linked to a copper ring which surrounds the iron core of a differential transformer. When pressure is applied to the unit, the spring positions the ring, inducing a differential voltage in the output winding proportional to the applied pressure. This voltage is transmitted to the recording instrument where it is measured and recorded as pressure.

The instrument is ordinarily calibrated for 500 feet of four conductor No. 18 cable, however, cable lengths of from 10 to 1000 feet result in an error a maximum span error of only .25 per cent.

Some of the features of this new instrument are:

- Calibration accuracy to within ±¼ percent of rating at any point within its range, when used over the entire range.
- Sensitivity limited only by the measuring instrument. With standard instruments, sensitivity of .001 percent has been obtained.
- Low temperature errors. For temperature changes of 100 degrees from an ambient of 75 F., temperature errors are within ±¼ percent of cell rating.
- Zero shift. By a micrometer screw adjustment, the zero position may be shifted ±100 percent of full range to zero out an initial pressure, or to compensate for any zero shift in the cell.
- Ranges. The units are available in ranges of from 0 to 30 in. Hg. vacuum and from 0 to 10,000, psi pressure.

For complete details on this new instrument, just . . .

Circle No. 11 on Postcard

DC Motor

A new totally enclosed, unit-cooled, DC motor for use in severe atmospheres has been announced by General Electric Company's Direct Current Motor and Generator department. This new motor is available in ratings from 15 to 200 horsepower. It features 50 percent greater heat transfer and a 37 percent smaller unit than previous designs. Compact cooling units mounted completely within the over-all length and width of the motors permit operation at extremely low speeds for long periods of time because ventilation is independent of motor speed. This independence is made possible by a double system of blowers assuring rapid cooling. One blower assembly forces cooling air from the room through the external passages of the cooler, while the other forces internal motor air through the closed internal passages of the air cooler. Complete information is available on this new line of motors now.

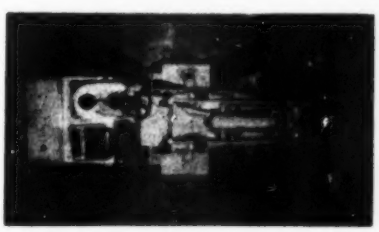
This item supplements General Electric Company data on pages 492-493 of The Refinery Catalog, 20th Edition.

Circle No. 12 on Postcard

Induction Motors

A new line of well protected versatile squirrel cage induction motors is being announced by Reliance Electric and Engineering Company. The line, including protected and enclosed motors for all industrial purposes, is being built to recently adopted standards of the NEMA. The first of these new motors to appear will be built for 1, 1½ and 2 horsepower applications. The balance of the line, up to and including 30 horsepower, will be introduced at regular intervals during 1954 and the early part of 1955. The new totally enclosed fan-cooled motors are built to operate under a wide variety of adverse atmospheric conditions and in any mountings. These motors include many features which the manufacturer has found important to industry today. Complete data on these motors and an informative "Comparaframe Chart" is available now. Simply . . .

Circle No. 13 on Postcard



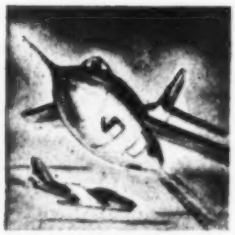
Shoveloader

A new materials handling Shoveloader is being offered by Baker-Lull Corpora-

Why **dbpc** antioxidant is 1st choice for Petroleum Products

motor fuels

aviation fuels



jet fuels

turbine oils

cutting oils

hydraulic oils

● **dbpc** (di-tert-butyl-para-cresol) offers you manifold advantages.

First of all, this Koppers antioxidant gives the highest possible protection against oxidation in petroleum products at very low cost. For example, in motor gasoline protection normally amounts to *less than one hundredth of a cent per gallon.*

Secondly, the versatility of **dbpc** warrants its use in a wide variety of petroleum products. The U. S. Government has approved **dbpc** as an inhibitor for aviation gasoline and jet fuels. It is widely used in motor gasolines, greases, lubricating oils, turbine oils, specialty oils, including cutting, spindle, and hydraulic oils, and many other oils where oxidation is a problem.

dbpc will not form deposits in carburetor fuel induction systems. It prevents the formation of gum in gasoline over long storage periods and will not impart color to the gasoline.

dbpc is safe to handle—non-toxic and non-irritating. Moreover, it is available in solid or solution form—called "Impruvol 33".

"dbpc" is only one of the many synthetic chemicals produced by Koppers. Others include Resorcinol, Styrene Monomer, Polystyrene, Phthalic Anhydride, and Divinylbenzene.

KOPPERS COMPANY, INC.

Chemical Division, Dept. PR-24, Pittsburgh 19, Pennsylvania

KOPPERS

Koppers Chemicals

SALES OFFICES: NEW YORK · BOSTON · PHILADELPHIA · ATLANTA
CHICAGO · DETROIT · LOS ANGELES

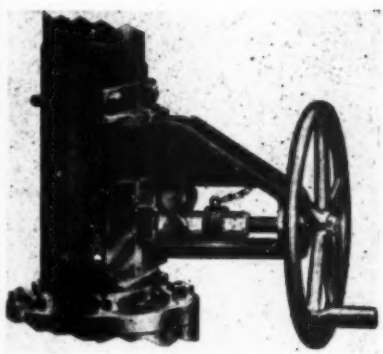
New Equipment . . .

tion. Equipped with positive four-wheel drive and designed to eliminate need for a center differential in the transfer case, the units have hi-flotation tires and high under-clearance which permits efficient operation of the loader under extreme conditions of mud, snow, sand and uneven ground. Some of the additional features of this new item are:

- Seven-foot-six-inch turning radius.
- Optional power steering on all four wheels.
- Maximum operator visibility.
- Nineteen-foot wheelbase.

For complete information on this new item, just . . .

Circle No. 14 on Postcard



Emergency Control

Black, Sivalls & Bryson, Inc., manufacturers of "Climax" automatic controls, is introducing a new type "Y" continuously connected side handwheel for emergency manual control in case of diaphragm or operating medium failure. The new device is designed to augment the use of diaphragm control valves in permitting plant operation on an emergency basis. Some of the features of this new type "Y" handwheel are:

- High tensile iron frame.
- Oil impregnated bearings.
- Handwheel screw made of non-galling 18-8 stainless steel.
- Allows manual positioning independent of normal controling impulses.
- Adjustable stops are provided.

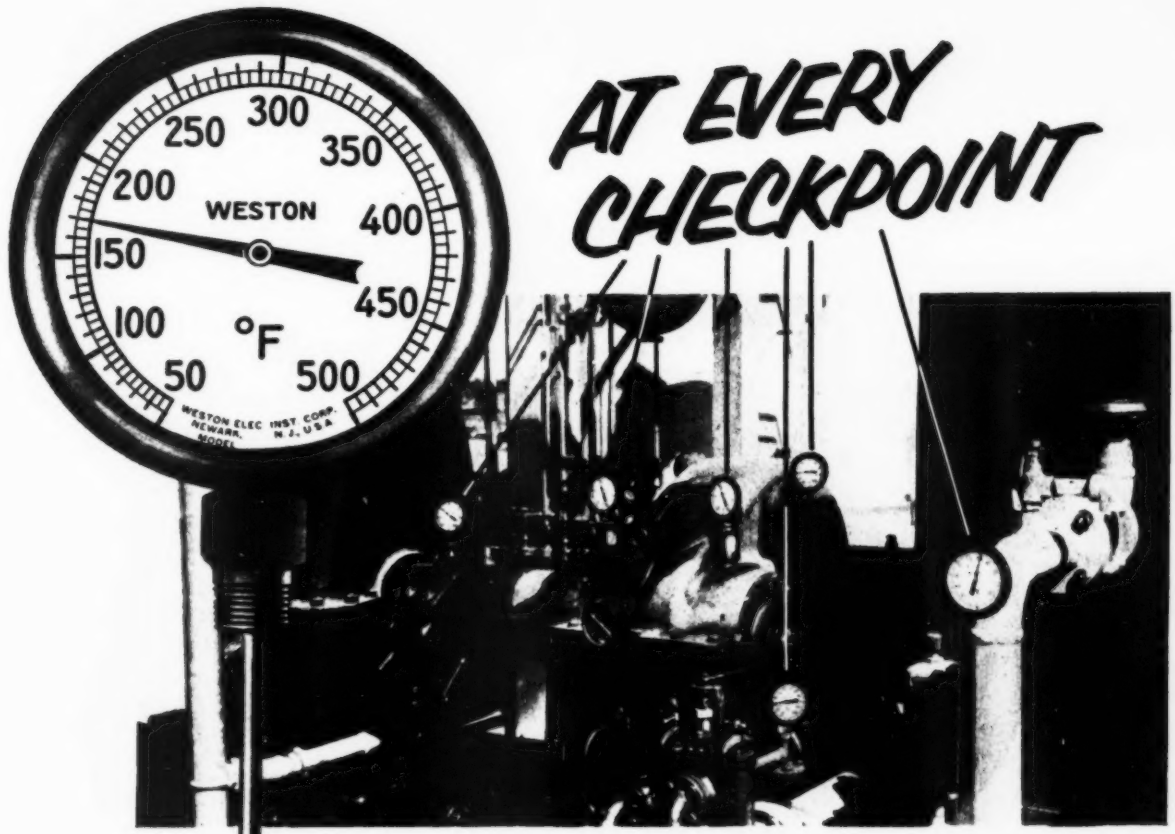
For the complete information you require in your application of this new product, use reader service card.

This item supplements Black, Sivalls & Bryson, Inc., data on pages 209-216 of The Refinery Catalog, 20th Edition.

Circle No. 15 on Postcard

Metallic Bellows

Titeflex, Inc., announces commercial production of its welded-diaphragm type metallic bellows in a variety of standard production sizes, and in any one of several different metals. Originally developed for atomic energy application, this new product should find wide application in the refining and petrochemical

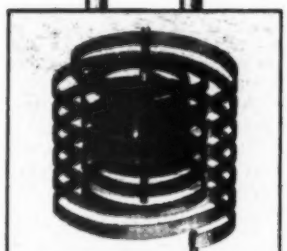


WESTON *all-metal* THERMOMETERS

(with Multiple Helix)*

Here's another typical example of how large processing plants have solved temperature checking problems, and cut thermometer costs besides. With a WESTON dial-type thermometer at every checkpoint, temperatures are read at a glance . . . in far less time, and with far greater accuracy. Their sturdy all-metal construction resists breakage, gives them far longer life on operating equipment. And the exclusive WESTON multiple helix employed assures dependable accuracy during all this long life.

Available in a broad selection of types, sizes, ranges and stem lengths, WESTON thermometers are today standard on all types of mobile and stationary equipment and machines, large and small; as well as on piping, conduit, ducts, etc. Ask your distributor, or local WESTON representative for complete information, or write for descriptive bulletin . . . WESTON Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, New Jersey.



***This WESTON-made sensing element is the more costly, non-sagging, multiple-helix. Carefully aged over a broad temperature range for long periods, it assures better accuracy, over a longer life.**

WESTON 5537 *Thermometers*

Stocked by leading Distributors

For Quickest Pipe Threading by hand... it's "OOR"

RIDGID

Popular Extra-Handy OOR Threads 1/8" to 1" Pipe Fast and Easily

- You just can't beat these small drop head dies for quick easy pipe or conduit threading.
- Snap the size head you want into the drive ring, from either side, and you're ready to cut clean perfect threads . . . heads can't fall out.
- Precision-cut alloy dies reverse easily for close-to-wall threads—no special dies needed.
- OOR and OR 1/8" to 1"; 111R and 11R, 1/8" to 1 1/4"; 12R, 1/8" to 2". Free carrier with sets. Every threader fully work tested before shipment. Buy them at your Supply House.

THE RIDGE TOOL COMPANY • ELYRIA, OHIO

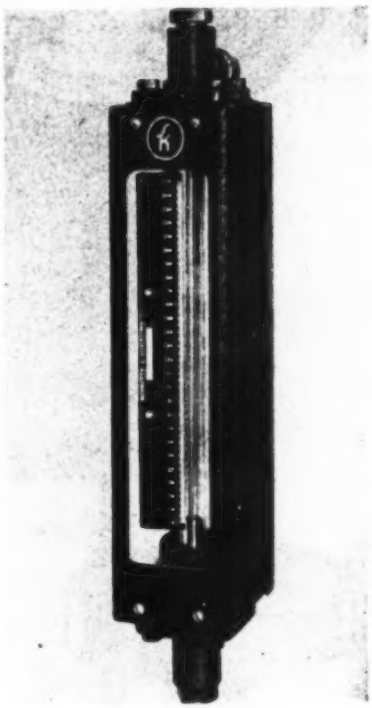
New Equipment . . .

industries as a shaft seal, expansion joint, and vibration absorber. Among the features mentioned in the announcement of this item are:

- Long life under corrosive conditions.
- Vibration and heat resistance.

For complete information on this new product just . . .

Circle No. 16 on Postcard



Rotameter

The new S K Safeguard Rotameter recently announced by Schutte & Koerting Company features safety, accuracy and versatility. This new line of Rotameters is made to handle flows of water between .031 and 90.2 gallons per minute. Some of the additional features of this new line of instruments are:

- Completely enclosed steel meter case.
- Detachable safety glass windows.
- Wide variety of rotor designs available.
- Adaptation for electric or pneumatic transmission and remote recording.
- Detachable metal reference scale.

For complete data on Safeguard Rotameters simply . . .

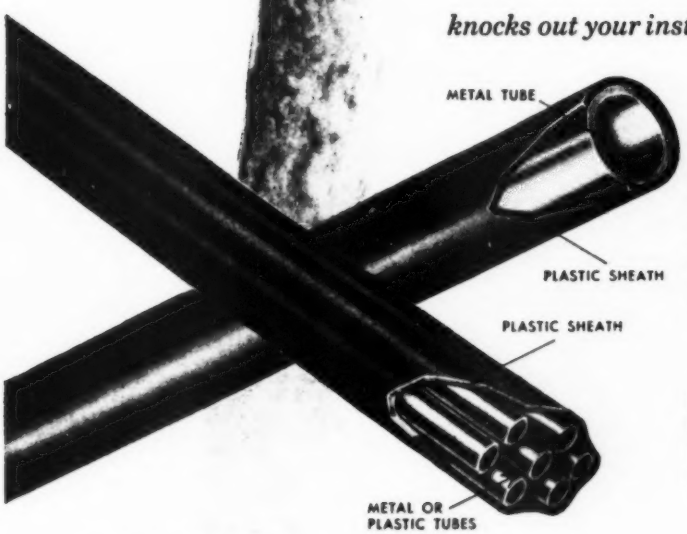
Circle No. 17 on Postcard

Platform Truck

A 4000 pound capacity high lift platform motorized hand truck has been added to the Worksaver line by Yale

DEKORON INSTRUMENT TUBING

knocks out your instrument line corrosion problems



DEKORON single-line tubing. Samuel Moore & Co. will coat your copper, aluminum or steel tubing by the Dekoron extrusion process, or will supply coated tubing. Straight lengths to 20 ft., coils to 1000 ft.

DEKORON IMPERVAPAK is a multiple tube harness of plastic or metal tubes encased in tight plastic sheath. Multiple tube construction cuts down installation costs.

Corrosion endangers the life line of your plant—your instrument tubing. That's why you should investigate Dekoron instrument tubing, the tubing that's impervious to moisture, salt air, corrosive atmospheres, and chemicals.

That means Dekoron eliminates replacement costs and maintenance. Other advantages are low initial cost . . . less plant down time . . . easy installation with standard fittings and plastic tape.

In replacement savings alone—not including lower maintenance and installation costs—Dekoron Instrument Tubing pays for itself over and over again.

A-7934

Send for free copy of Bulletin L-6506 "3 Ways to Whip Corrosion and High Tubing Installation Costs in Your Plant."

Dekoron® tubing

SAMUEL MOORE & COMPANY
DEKORON TUBING DIVISION • MANTUA, OHIO

AIRETOOL SOLVES 2 major tube maintenance problems

Geared air driven condenser cleaner

Spiral brush

Reamer

Straight flute drill

CLEANING

Here's the cleaner for heavily scaled small diameter tubes in heat exchangers, condensers. A powerful low speed motor enables the operator to clean without tube injury. A flushing agent is introduced through the motor and drive shaft to keep the drill cool under all scale conditions. Special packing glands prevent leakage. Designed for thorough, safe cleaning of all scale conditions.

EXPANDING

It's new! Rolls tight tube joints automatically by the Retractive Method! Control is set to desired expansion, expander is fully inserted and rolls a short section of the tube. When full expansion is reached, the Expander then automatically retracts, expanding the entire thickness of the tube sheet. This method draws metal toward mouth of tube, prevents elongation, distortion or enlargement of holes, reduces time needed to roll tight joints.

Airetool Automatic Retractive Tube Expansion Control System — for installing tubes in heat exchangers, condensers, boilers.

Write for details about tube cleaning, tube expanding.

BRANCH OFFICES:
New York • Chicago • Philadelphia
Tulsa • Houston • Baton Rouge
Hudson Heights (NJ)

Representatives in principal cities of U. S. A., Canada, Mexico, South America, England.

AIRETOOL
MANUFACTURING COMPANY
SPRINGFIELD, OHIO

THERE'S AN AIRETOOL TUBE EXPANDER OR TUBE CLEANER FOR EVERY TYPE OF TUBULAR CONSTRUCTION.

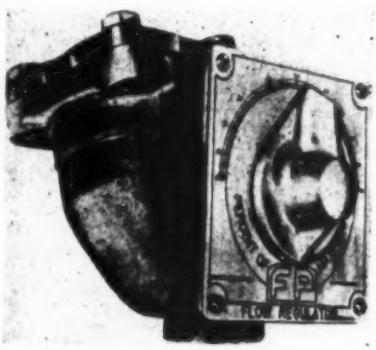
New Equipment . . .

materials handling division of the Yale and Towne Manufacturing Company. Available with platform lengths up to 60 inches, this maneuverable truck will lift a platform 120 inches above floor level. Side to side stability is provided by two widely spaced heavy duty caster wheels. Some of the features of this new model are:

- Compact size.
- Light weight.
- Simplified operation.

Complete information on this new product is available now. Just . . .

Circle No. 18 on Postcard



Flow Regulator

A low cost automatic flow regulator which is compact, simple in design and self-operated, has just been made available to the refining and petrochemical industries by Fischer & Porter Company. The unit, which can be screwed directly into a pipe line, maintains a preset flow rate despite changes in upstream or downstream pressures. Operated entirely by liquid passing through it, this is one of the few instruments on the market offering flow control for that broad field of applications which do not justify costly pneumatic or electric control equipment but which are too complicated to be trusted to manually operated valves. Some of the features of this new regulator are:

- Easy maintenance.
- No outside source of energy required.
- Adaptable to in-line or panel mounting.
- Three sizes available, 0.5-5, 1.0-15, 6-80 gpm.
- Units made of either bronze or stainless steel.

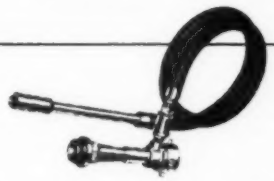
Complete engineering data are available now. Just . . .

Circle No. 19 on Postcard

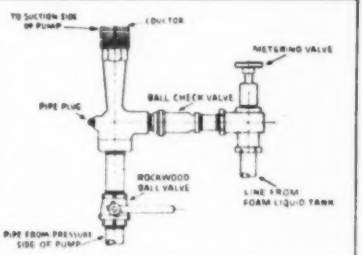
Deaerator

Cochrane Corporation has announced a new line of deaerators completely factory assembled and ready for installation in a variety of storage tank sizes. Called the Uni-Pac deaerator, it is a package type unit specially designed for small and medium size power plants. Some of

This Rockwood equipment puts Rockwood FOAM to work for you —



Foam Eductor introduces Rockwood FOAM into hose lines for use with Rockwood type FFF FogFOAM Nozzles. Connects discharge gate of fire trucks to hose line — hydrant to hose line — or one length of hose to another. In 1½" and 2½" sizes. Operates from 75 to 175 p.s.i. at Eductor inlet. Approved by Underwriters' Laboratories, Inc.



Around-the-Pump Proportioner Model Dual "B" automatically feeds FOAM into hose lines, assures accurate mixing. Used when pressure is maintained at pump. Operates in range from ¾" booster lines to 2½" hose lines. Maximum discharge 400 g.p.m. Custom engineered proportioning systems for fire trucks, crash trucks, etc. also available. Write for details.

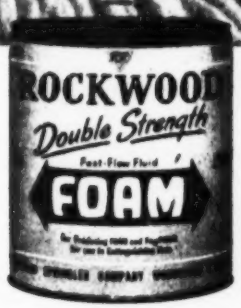
Type SG-60 FogFOAM Nozzle with FF extension features FogFOAM and solid FOAM stream discharge. Performance for FogFOAM — 450 g.p.m. at 100 p.s.i. — for solid FOAM stream 500 g.p.m. at 100 p.s.i. Approved by Underwriters' Laboratories, Inc.

Type FFF FogFOAM Nozzle with FogFOAM screen discharges wide pattern of FogFOAM. Also available with shaper to discharge long solid FOAM stream. For 1½", 2½" and 3½" hose lines. 2½" size discharges 200 g.p.m. at 100 p.s.i. Approved by Underwriters' Laboratories, Inc.

The Evening Bulletin, Philadelphia

Gasoline Fires Quenched Quicker

Put fire-fighting punch into ordinary water! Three parts of Rockwood Double-Strength Fast-Flow Fluid FOAM mixed with 97 parts water produces the flame-smothering FOAM blanket above. Spreads rapidly even at sub-zero temperatures. Seals off combustible vapors, flows freely around construction. Quickly re-seals if broken. A boon to fire-fighters!



APPROVED BY UNDERWRITERS' LABORATORIES, INC.
Comes in 5 gallon cans or 50-gallon drums.

Standard Straight Foam Play Pipe and FOAM Pick-Up Tube discharge FOAM from 1½" hose line. Discharges 60 g.p.m. at 100 p.s.i. Range: approximately 55 feet. Approved by Underwriters' Laboratories, Inc. and FML.

SEND FOR THIS INFORMATIVE BOOKLET

ROCKWOOD SPRINKLER COMPANY
Portable Fire Protection Division
102 Harlow Street
Worcester 5, Mass.

Please send me your illustrated booklet on Rockwood fire fighting products.

Name .....
Title .....
Company .....
Street .....
City .....
Zone ..... State .....

ROCKWOOD SPRINKLER COMPANY

Engineers Water . . . to Cut Fire Losses

Planning for profits with PERCO*

Refiners rely on Perco for expert advice and consultation to improve refining performance, by the efficient utilization of Perco processes.

Perco offers many services. One of our engineers will be glad to review the economic application of the Perco process best suited to your needs.

Make the most of *your* throughput—*consult Perco.*

Over 175 installations licensed by Perco throughout the United States, Canada, Europe, and Latin America prove the wide application of Perco processes to current refining problems.

Now is the time to upgrade your throughput.

Write Perco today for full information.

PERCO *Division*

PHILLIPS PETROLEUM COMPANY

PERCO®
*A SERVICE MARK

Bartlesville, Oklahoma

New Equipment . . .

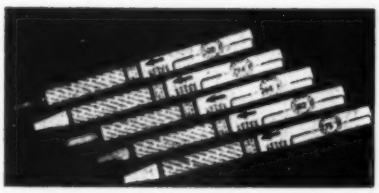
the advantages offered by these units are:

- Easy installation.
- Custom engineered features at stock prices.
- Oxygen content of deaerated water less than seven parts per billion.

With outlet capacities up to 60,000 pounds per hour, this new product should find ready application in the refining and petrochemical industries. For complete information use reader service card.

This item supplements Cochrane Corporation data on page 333 of The Refinery Catalog, 20th Edition.

Circle No. 20 on Postcard



Temperature Measurement

Tempil Corporation announces the development of new Tempilstiks covering the temperature range from 282 F. to 294 F. By providing a simple and accurate means of checking temperatures, Tempilstiks should find many applications in the refining and petrochemical industry. In use, the appropriate Tempilstik is stroked lightly on the surface to be tested. A liquid smear will show as soon as the temperature reaches the rating of the stick used. These useful aids are manufactured in a much wider range than that just announced. Complete information on the entire line of Tempilstiks is available now. Simply

Circle No. 21 on Postcard

Computing Services

High-speed computation services, performed automatically on the Burroughs Laboratory Computer—Model I, are now available to the refining and petrochemical industries at the Philadelphia Research Center of Burroughs Corporation.

Developed and improved over the last two years for laboratory study, this electronic digital computer has been proven on a regular schedule of computations originating both within and without the Burroughs Research organization. Test problems for outside groups have included turbo-engine design and performance calculations, pipe stress calculations for chemical plants, statistical correlations, and others. An expanded programming staff now permits the handling of exploratory problems for other groups that wish to evaluate the use of electronic digital computers.

General features of the Burroughs Laboratory Computer include:

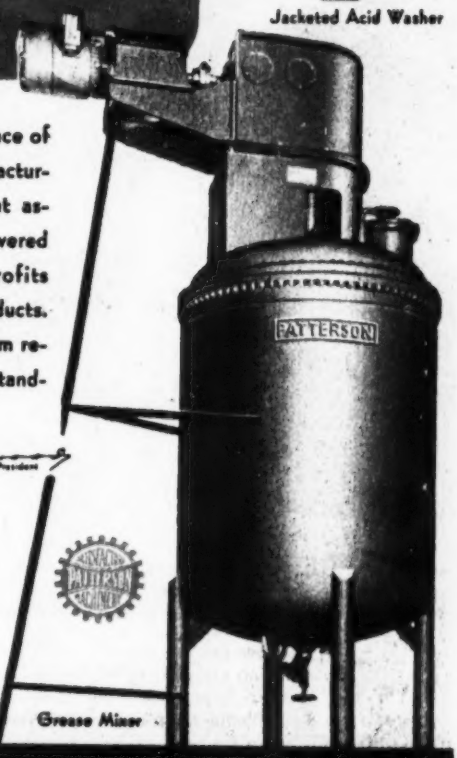
- Magnetic drum memory systems.
- Punched paper tape input and output.

EFFICIENT, FAST
PROFITABLE
PROCESSING
for every batch!
Patterson
PROCESSING EQUIPMENT

Jacketed Acid Washer

• Reflecting the experience of nearly 90 years of manufacturing, Patterson Equipment assures profits through lowered processing costs . . . profits through improved end-products. Available for the petroleum refiner is a wide range of standard equipment.

Richard L. Cameron
President



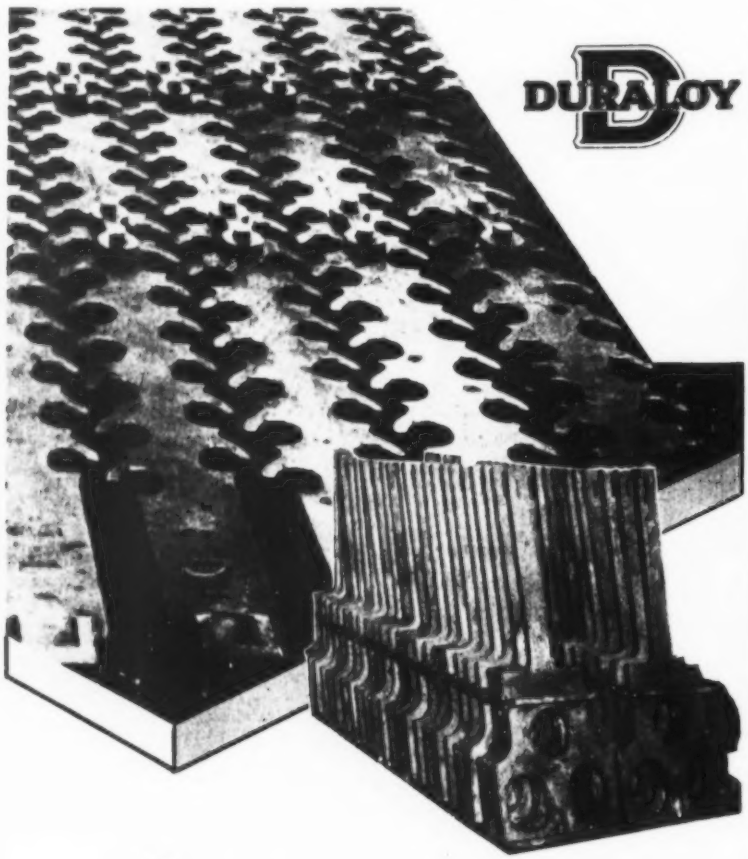
Grease Mixer

ESTABLISHED DESIGNERS AND BUILDERS OF
• Mixers
• Kettles
• Agitators
• Pressure Vessels

The Patterson Foundry and Machine Company
East Liverpool, Ohio, U. S. A.

The Patterson Foundry and Machine Company (Canada) Limited
Toronto, Canada

CORROSION RESISTANT
HEAT RESISTANT
Tube Supports



You can't buy Better Tube Supports . . . DURALOY Tube Supports are alloyed to meet individual corrosion and heat requirements. They are alloyed by experienced metallurgists and melted and cast by experienced high-alloy foundrymen, both groups with experience going back some thirty years. Castings are carefully tested in our own laboratories which are completely equipped for metallurgical, chemical and physical testing.

Many refineries have been DURALOY customers for years. Many refineries insist upon DURALOY castings. Whether its straight production or engineering plus production, we are equipped to do the job. For more information, send for Bulletin No. 3150-G.

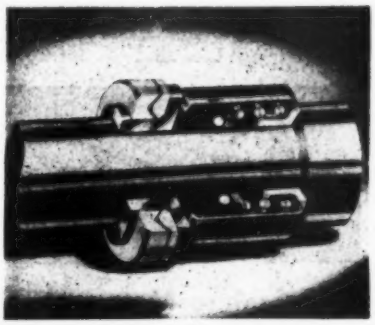
THE DURALOY COMPANY

New Equipment . . .

- Photoelectric read-in.
- Extensive error checking circuitry.

The computer is largely made up of more than 750 standard electronic building blocks, known as Burroughs Pulse Control Units, which are widely used as test equipment in research on computers. The time required for an addition is .017 seconds, for multiplication .050 seconds. Complete information on this new service is available now. Just . . .

Circle No. 22 on Postcard



Rotary Shaft Seals

Mechanical seals consisting of one rotating and one stationary member mounted flexibly enough for the flat rubbing faces to be fluid tight when forced together by mechanical and/or fluid load are not new, but the incorporation of sealing parts made of Teflon, Kel-F, Buna-N, and silicone rubber is a new and important development. It has expanded the limits on temperature and types of liquids on which mechanical seals can be used in refineries and petrochemical plants. The Garlock Packing Company, which has been instrumental in developing the use of plastics and synthetic rubber in mechanical seals, is now offering mechanical seals using these plastics as well as others. Available for use with pressures as high as 1000 psi, these seals may be used in services handling oils, solvents, strong acids and other corrosive and hazardous chemicals. Send for full information on these important new developments.

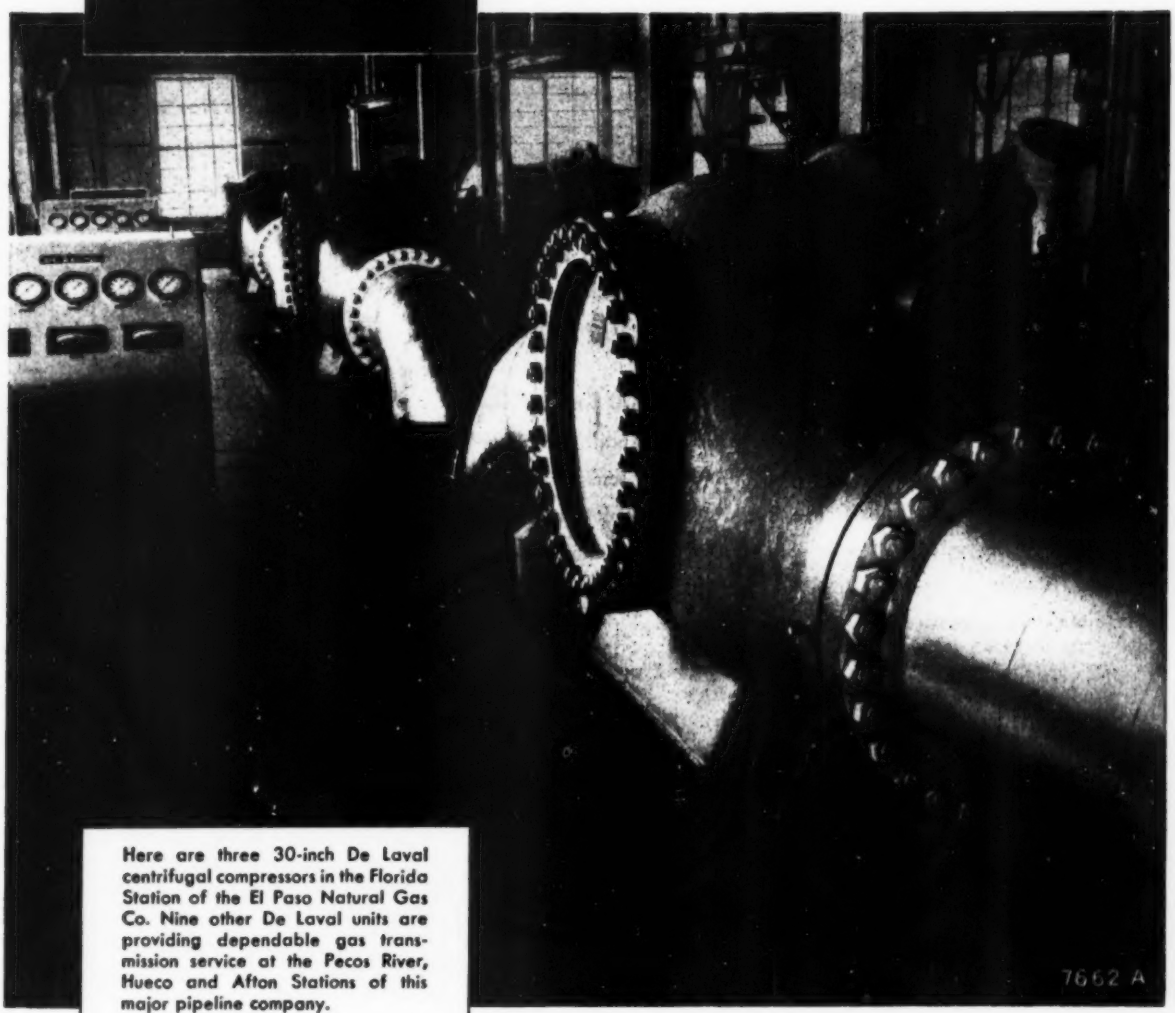
This item supplements Garlock Packing Company data on page 489 of The Refinery Catalog, 20th Edition.

Circle No. 23 on Postcard

Grooved End Valve

A new grooved end version of its standard two-bolt yoke type Nordstrom semi-steel lubricated plug valves has been introduced by Rockwell Manufacturing Company to make it possible to connect valves to steel pipe with grooved end couplings. With this method, a tight, permanent connection can be made in a matter of minutes and lines may be dismantled as often as necessary without damage to the pipe or grooved end couplings. Another feature of this method is the elimination of the

DE LAVAL CENTRIFUGAL COMPRESSORS *on the job at El Paso Natural Gas*



Here are three 30-inch De Laval centrifugal compressors in the Florida Station of the El Paso Natural Gas Co. Nine other De Laval units are providing dependable gas transmission service at the Pecos River, Hueco and Afton Stations of this major pipeline company.

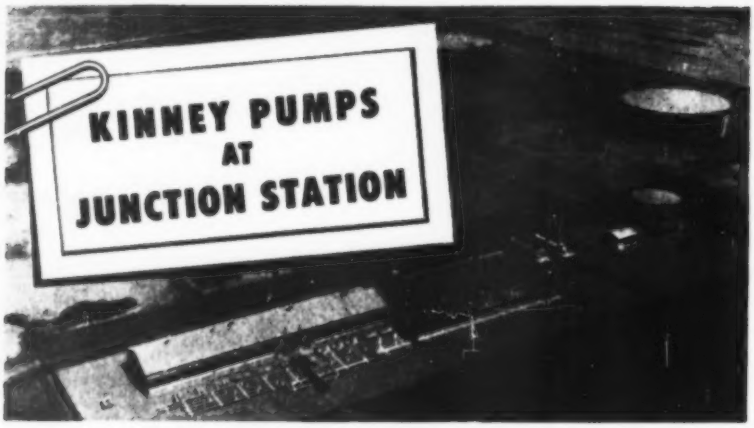
De Laval centrifugal compressors offer many important engineering features. (1) They are designed to handle an increased ultimate flow, can be quickly converted to larger capacities by replacing the impeller, diaphragm and a few minor parts. (2) The high pressure shaft seal eliminates leakage, consumption of sealing oil is negligible. (3) There is only one moving part — the rotor — which has ample clearance. (4) Units are compact, require smaller foundations and smaller stations. (5) First costs and installation costs are low.

If you want detailed data on all the design advantages of De Laval centrifugal compressors, consult our engineers. They will be glad to give you the benefit of our wide experience on major pipelines.

DE LAVAL *Centrifugal Compressors*

DE LAVAL STEAM TURBINE COMPANY
811 Nottingham Way, Trenton 2, New Jersey

DL 220



The West's most modern pumping station — Union Oil Company of California's Junction Station — uses the world's most dependable pumps — Kinney Model HQA Heliquad Rotary Pumps. These smooth-pumping units contribute their part to the over-all smooth operation of this up-to-the-minute pumping station.

For positive displacement pumping at its best, whether the viscosity is high or low, it pays to pick Kinney Heliquads. Available in iron, steel, or bronze constructions, with displacements from 20 to 2700 GPM — for pressures from 50 to 300 psig depending upon type of liquid and size of pump. Send for complete details. Kinney Mfg. Division, Boston 30, Mass. Representatives in principal cities of the United States and foreign countries.

Close-up of Kinney Model HQA Heliquad Rotary Pump at Junction Station showing main pump line, manually operated by-pass, and automatic, pressure relief by-pass. Kinney Pumps furnished complete with bases, motors, and gear reduction units.

Kinney

KINNEY MFG. DIVISION
THE NEW YORK AIR BRAKE COMPANY
3596 WASHINGTON STREET • BOSTON 30 • MASS.

Please send Bulletin L-51 describing complete line of Kinney Rotary Liquid Pumps.

Name .....
Company .....
Address .....
City ..... State .....

New Equipment . . .

need for level ditching because a deflection of several degrees at every joint allows the lines to follow the uneven contours of the ground. The new valve is wrench operated and has a pressure rating of 175 psi, WOG. It is now being made in 2, 2½, 3, and 4 inch sizes. For complete details on this new valve line, use the reader service card.

This item supplements Rockwell Manufacturing Company data on pages 773-780 of The Refinery Catalog, 20th Edition.

Circle No. 24 on Postcard

Truck Mounted Shovel

Clark Equipment Company has announced the addition of two new ¾-cubic-yard capacity power shovel-cranes to its "Michigan" line of excavators and cranes. Shown in the photograph is the equipment in use as a crane, handling heavy steel beams. The new ¾-cubic-yard equipment will be manufactured in two truck-mounted models and one crawler model and will be available for delivery this spring. Complete details on these units are available now. Simply . . .

Circle No. 25 on Postcard

Control Valves

A new line of diaphragm motor control valves, incorporating a number of engineering improvements, was recently announced by the Industrial division of Minneapolis-Honeywell Regulator Company. This new line, to be designated "Series 800," was designed for use with wide-band, proportional control instruments used in the Refining and petrochemical industry. Some of the features of this new valve line are:

- Redesigned diaphragm motor.
- Pressed steel case plates.
- Rugged yoke with mounting bosses on both sides for mounting auxiliary equipment.
- Unique locking arrangement.
- Bolted or screwed stuffing boxes available.

The new line also incorporates direct-acting, reverse-acting and springless diaphragm motors. These are for operation of either double and single-seated straight-through bodies or for Venturi, three-way, and low flow types of bodies. Complete engineering data is available now. Just . . .

Circle No. 26 on Postcard

What's New In Equipment Listing, Page 210

FREE CATALOG!

available to you who are interested in the facts on open steel flooring.

Up to the minute information on the hows and whys of construction and installation of Tri-Lok Open Steel Flooring may now be at your finger-tips. Here is a four-page catalog designed to aid you in selecting the best types and styles of open-steel flooring for your particular construction project.

IN THIS CATALOG YOU'LL FIND

- Tables of Safe Loads
- Specifications required for open steel flooring installation
- Types of Tri-Lok Open Steel Flooring available
- Information concerning construction, sizes, strength and adaptability of Tri-Lok Open Steel Flooring

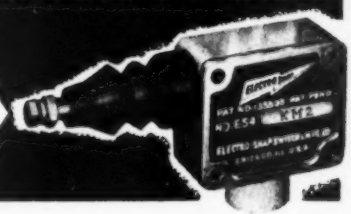
FOR YOUR COPY, WRITE FOR BULLETIN PW 1102-243

DRAVO
CORPORATION
National Distributor for THE TRI-LOK COMPANY
Fifth and Liberty Avenues, Pittsburgh 22, Pa.

ELECTRO SNAP

ONE WAY
IMPULSE SWITCH
FOR SIMPLIFIED CONTROL

EXCLUSIVE ACTUATOR LETS YOU DO THINGS YOU NEVER COULD BEFORE!



Model ES4-KM2

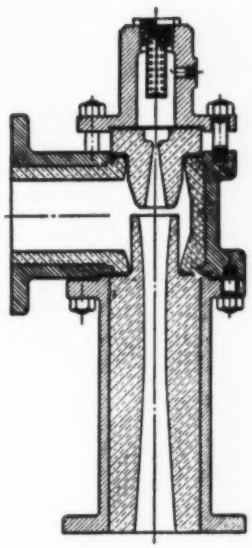
- **Eliminates Interlocking Switches and Complicated Actuating Dogs—** Ideal for pulsing solenoid valves, air-hydraulic cylinders.
- **Gives More Dependable Operation—** Replaces complicated controls.
- **Lowers Cost of Controls Circuits—** Fewer switches, etc., required.
- **Faster Automatic Operation—** Closer sequencing possible.

Switch rated at 10 amps, 125/250 v. AC. Four models available with overtravel and pulsing strokes from 1/16" to ⅜". Write for Data Sheet ESN-2.

see our catalog in PRODUCT DESIGN FILE or write for copy

ELECTRO-SNAP SWITCH AND MFG. CO.
4224 West Lake Street, Chicago 24, Illinois

C-R EVACTORS



MEET CORROSION PROBLEMS

The chemical industries are employing more and more Croll-Reynolds Evactors in vacuum processes where corrosion resistance is a major consideration. These steam jet vacuum units provide pressures ranging from a few inches to a few microns. Croll-Reynolds is a pioneer in the use of new construction materials and our engineers are investigating corrosion problems continually.

Stainless steels, Monel metal, Beryllium copper, Ni-Resist, PMG metal, hard lead, special bronzes, Hastelloy, and Illium are but a few of the special metals which find their way into our equipment. Carbon is used extensively as a lining material, and many plastics including Teflon and other synthetic materials are used for making complete Evactors.

Consult our engineers for high vacuum equipment carefully designed for your specific conditions, and constructed of materials selected for your particular conditions.

CROLL C R REYNOLDS

CROLL-REYNOLDS CO., Inc.

Main Office: 751 Central Avenue, Westfield, N. J.
New York Office: 17 John Street, New York 38, N. Y.

CHILL VACTORS • STEAM JET EVACTORS • CONDENSING EQUIPMENT

Equipment Literature

TECHNICAL DATA, BULLETINS, CATALOGS AVAILABLE WITHOUT COST AS MENTIONED BY ADVERTISERS IN THIS ISSUE.

Use the Reader Service Postcards inserted at page 196. Just circle on the card the identifying key number of each item in which you are interested. Show complete mailing address.

AIR PREHEATER—Catalog L-5. The Air Preheater Corp. See page 44.
Circle A1 on postcard.

ALLOY CASTINGS—Booklet. The International Nickel Co. See page 177.
Circle H10 on postcard.

ANTIOXIDANT SWEETENING—Booklet No. 22. E. I. du Pont de Nemours & Co. See page 90.
Circle F3 on postcard.

ASBESTOS BUILDING MATERIAL—Information. Keasbey & Mattison Co. See page 81.
Circle J4 on postcard.

BOLT STUDS—Bulletin. Kilbourn Engineering Co. See page 214.
Circle J7 on postcard.

BUBBLE CAPS AND RISERS—Catalog 52. The Pressed Steel Co. See page 191.
Circle P3 on postcard.

CATALYST SUPPORTS—Information. Norton Company. See page 18.
Circle M4 on postcard.

CATALYTIC CONSTRUCTION—Information. Catalytic Construction Co. See page 78.
Circle C9 on postcard.

CENTRIFUGAL PUMPS—Bulletin W341-B16. Worthington Corp. See page 21.
Circle T9 on postcard.

CIRCUIT BREAKER-MOTOR STARTER—Bulletin B11. Appleton Electric Co. See pgs. 170-171.
Circle B2 on postcard.

COLLOIDAL CONCENTRATE—Literature. American Sand-Banum Co. See page 252.
Circle B1 on postcard.

COMPRESSORS—Bulletin 130. Clark Bros. Co. See pages 48-49.
Circle D6 on postcard.

CONCRETE CONSTRUCTION—Bulletins. Gunite Concrete & Construction Co. See page 256.
Circle H5 on postcard.

CONDENSER TUBES—Booklet. Revere Copper & Brass Inc. See page 161.
Circle Q2 on postcard.

CONDENSER TUBES—Book. Wolverine Tube Division. See page 179.
Circle T8 on postcard.

CONTROLLERS—Bulletin 98151. Taylor Instrument Companies. See pages 58-59.
Circle R9 on postcard.

CORROSION INHIBITOR—Information. Atlas Powder Co. See page 35.
Circle B3 on postcard.

CRANES, EXCAVATORS—Information. Schield Bantam Company. See page 195.
Circle Q8 on postcard.

CUTTING, WELDING MACHINES—Catalog. Air Reduction Magnolia Co. See pgs. opp. 229.
Circle A2 on postcard.

DEMISTER—Catalog 13. Otto H. York Co., Inc. See page 228.
Circle U1 on postcard.

DESALTING PROCESS — Information. Petrolite Corp. See page 55.
Circle N9 on postcard.

DIAL THERMOMETERS—Bulletin 51-129. Palmer Thermometers, Inc. See page 218.
Circle M10 on postcard.

DIAPHRAGM OPERATORS—Information. Black, Sivalls & Bryson, Inc. See page 57.
Circle C2 on postcard.

DIFFERENTIAL CONVERTERS—Bulletin 2280. Minneapolis-Honeywell Regulator Co. See pgs. 72-73.
Circle L4 on postcard.

DUAL STAGE BURNERS—Bulletin 25. National Airoil Burner Co., Inc. See page 226.
Circle L8 on postcard.

DUST COLLECTION AND RECOVERY—Information. Buell Engineering Co. See page 65.
Circle C8 on postcard.

ELECTRIC MOTORS—Bulletin MU-132. Wagner Electric Corp. See page 80.
Circle S10 on postcard.

EXPANSION JOINTS—Booklet. Flexonics Corp. See page 168.
Circle G2 on postcard.

FANS, BLOWERS, VENTILATORS—Bulletin 1503. Hartzell Propeller Fan Co. See page 260.
Circle H6 on postcard.

FIRE FIGHTING PRODUCTS—Booklet. Rockwood Sprinkler Co. See page 205.
Circle Q6 on postcard.

FITTINGS—Catalog 153. The J. B. Beaird Co. See page opp. 33.
Circle B9 on postcard.

FLOW TUBES—Information. Foster Engineering Co. See page 180.
Circle G4 on postcard.

FLUID COKING PROCESS—Information. The Refinery Engineering Co. See page 192.
Circle P9 on postcard.

FORGED STEEL FITTINGS—Information. Watson-Stillman Fittings Division. See page 245.
Circle T3 on postcard.

FURFURAL—Bulletin 203. The Quaker Oats Co. See page 185.
Circle P6 on postcard.

GAGE SETS—Catalog 35. Penberthy Injector Company. See page 56.
Circle N4 on postcard.

GATE VALVES—Information. Walworth Company. See page 82.
Circle T1 on postcard.

GLASS INSULATION—Literature. Pittsburgh Corning Corp. See page 43.
Circle P1 on postcard.

HEAT EXCHANGERS—Bulletin. Whitlock Manufacturing Co. See page 189.
Circle T6 on postcard.

HEATING EQUIPMENT—Bulletin C-45. Struthers Wells Corps. See page 67.
Circle R7 on postcard.

IMPULSE SWITCH—Data Sheet TSN-2. Electro-Snap Switch & Mfg. Co. See page 209.
Circle F6 on postcard.

INHIBITOR-SWEETENING—Information. Eastman Chemical Products, Inc. See page 54.
Circle F5 on postcard.

INSTRUMENT TUBING—Bulletin L-6506. Samuel Moore & Co. See page 201.
Circle L6 on postcard.

INSULATED WIRE—Information. Claud S. Gordon Co. See page 226.
Circle G10 on postcard.

INSULATING CEMENT—Information. Baldwin-Hill Company. See page 194.
Circle B7 on postcard.

LIQUID PUMPS—Bulletin L-51. Kinney Mfg. Division. See page 208.
Circle J8 on postcard.

MAINTENANCE CLEANING—Booklet F7629. Oakite Products, Inc. See page 242.
Circle M5 on postcard.

MATERIALS HANDLING EQUIPMENT—Information. Dempster Brothers. See page 71.
Circle R8 on postcard.

MEASUREMENT INSTRUMENTS—Bulletin 115. Central Scientific Co. See page 32.
Circle D1 on postcard.

MIXERS—Catalog. Mixing Equipment Co. See page 88.
Circle L5 on postcard.

OPEN STEEL FLOORING—Bulletin PW 1102-243. Dravo Corp. See page 209.
Circle F1 on postcard.

ORGANICS—Bulletin. Nitrogen Division. Allied Chemical & Dye Corp. See page 11.
Circle M2 on postcard.

PACKAGED COMPRESSOR PLANTS—Information. The J. B. Beaird Co. See page opposite 32.
Circle B8 on postcard.

PAINT SELECTION GUIDE—Brochure No. B-770. The Sherwin-Williams Co. See page 87.
Circle R1 on postcard.

PRESSURE CONTROLS—Bulletin E-3500. Fisher Governor Company. See page 47.
Circle G1 on postcard.

PROCESS CONTROL SYSTEM—Catalog No. 164. Manning, Maxwell & Moore, Inc. See page 52.
Circle K7 on postcard.

PROCESS PUMPS—Bulletins 101 and 108. Pacific Pumps, Inc. See page 221.
Circle M8 on postcard.

PROCESSING EQUIPMENT—Booklet. Newport News Shipbuilding and Dry Dock Co. See page 181.
Circle L10 on postcard.

PUMPING UNITS—Literature. Southern Engine & Pump Co. See page 253.
Circle R2 on postcard.

PUMPS—Bulletin 52B7775. Allis-Chalmers Manufacturing Co. See pages 28-29
Circle A4 on postcard

RECORDER—Information. The Bristol Company. See page 8.
Circle C6 on postcard.

SHAFT SEAL—Booklet. Crane Packing Co. See page 193.
Circle E3 on postcard.

STEAM GENERATORS—Bulletins. Henry Vogt Machine Co. See page 247.
Circle S8 on postcard.

STEAM TRAPS—Catalog 953. W. H. Nicholson & Co. See page 4.
Circle M1 on postcard.

STEAM TRAPS—Sarco Company, Inc. See page 57.
Circle Q7 on postcard.

STEAM TRAPS—Bulletin T-1740. Yarnall-Waring Company. See II Cover.
Circle T10 on postcard.

STEEL GRATING—Bulletin No. 2365-R. Blaw-Knox Company. See page 184.
Circle C3 on postcard.

STEEL TUBING—Catalog. Pacific Tube Company. See page 5.
Circle M9 on postcard.

SULPHUR-DIOXIDE—Information. Tennessee Corporation. See page 244.
Circle R10 on postcard.

SULPHUR RECOVERY PLANT—Information. J. F. Pritchard & Co. See page 27.
Circle P4 on postcard.

TANK AND PRESSURE VESSEL FABRICATION—Catalog. Nooter Corporation. See page 94.
Circle M3 on postcard.

TANK TRAILERS—Information. Lubbock Machine & Supply Co. See page 249.
Circle K2 on postcard.

THERMAL CONTROLS—Catalog. Fenwal Inc. See page 74.
Circle F10 on postcard.

THERMOCOUPLES—Catalog 22X. Thermo Electric Co. See page 172.
Circle S3 on postcard.

THERMOMETERS—Bulletin. Weston Electrical Instrument Corp. See page 199.
Circle T5 on postcard.

TUBE CLEANERS AND EXPANDERS—Details. Airetool Manufacturing Co. See page 202.
Circle A3 on postcard.

TUBE CLEANERS—Bulletin Y-34. Elliott Company. See page 163.
Circle F7 on postcard.

TUBE EXPANDERS—Bulletin. The Gustav Wiedeke Co. See page 222.
Circle T7 on postcard.

TUBE SUPPORTS—Bulletin No. 3150-G. The Duraloy Company. See page 206.
Circle F4 on postcard.

TUBING ANALYSES—Information. National Tube Division. See page 86.
Circle L9 on postcard.

TURBINES—Bulletin S-146. The Terry Steam Turbine Co. See page 220.
Circle S1 on postcard.

TURBO PUMP—Bulletin PR 154. The J. S. Coffin, Jr., Co. See page 183.
Circle D8 on postcard.

UNIONS—Catalog 11. Catawissa Valve & Fittings Co. See page 250.
Circle C01 on postcard.

VALVE LUBRICANT—Details. Jet-Lube, Inc. See page 252.
Circle J2 on postcard.

VALVES—Catalog 10. The Chapman Valve Manufacturing Co. See page 42.
Circle D2 on postcard.

VALVES—Bulletin V-217. Rockwell Manufacturing Co. See pages 60-61.
Circle Q4 on postcard.

WATER SEPARATORS—Process Manual R-101-53. Warner Lewis Company. See page 225.
Circle K1 on postcard.

WATER TREATMENT—Details. Layne & Bowler, Inc. See page 25.
Circle J10 on postcard.

WELDED GRATING—Information. Standard Steel Spring Division. See page 255.
Circle R4 on postcard.

WELDING FITTINGS—Catalog 54. Midwest Piping Company, Inc. See page 40.
Circle L3 on postcard.

A major oil refining company on the eastern seaboard is building a catalytic reforming plant with capacity of 17,600 barrels per day....

. . . and PETROCHEM-ISOFLOW Furnaces will charge this 17,600 bpd plant.

A major oil refining company on the Texas gulf coast is building a catalytic reforming plant with capacity of 21,000 barrels per day....

PETROCHEM-ISOFLOW Furnaces

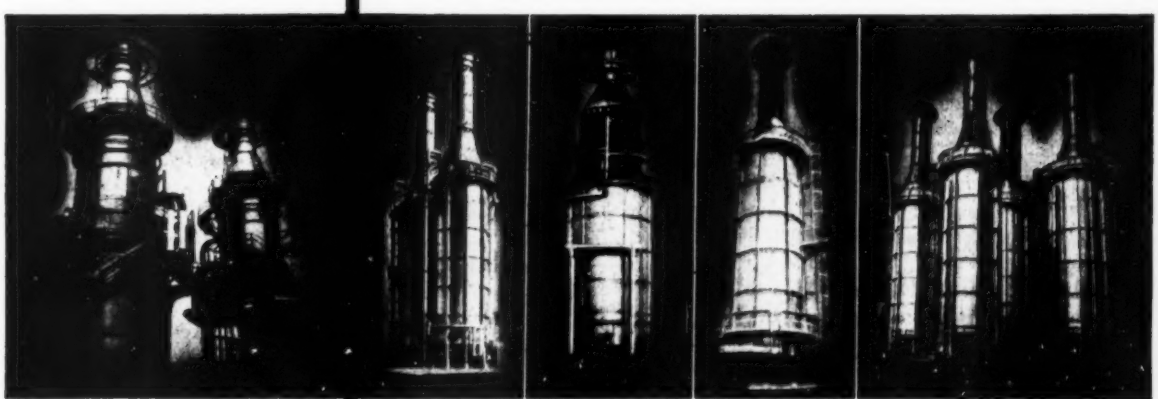
. . . and PETROCHEM-ISOFLOW Furnaces will charge this 21,000 bpd plant.

purchased for two of the largest cat reformers

Our first cat reformer heaters went into operation three years ago. Since then, we have sold catalytic reforming heaters for plants ranging from 1,000 barrels to 21,000 barrels per day. If you anticipate the installation of a catalytic reformer of any type, you will profit by investigating PETROCHEM-ISOFLOW heaters for this service.

More than 1150 Petrochem-Isoflow Furnaces are in operation throughout the world in the petroleum, chemical and allied industries . . . for all processes and for any duty, pressure, temperature and efficiency . . . and all

Petrochem-Isoflow Furnaces are most efficient by any comparison.

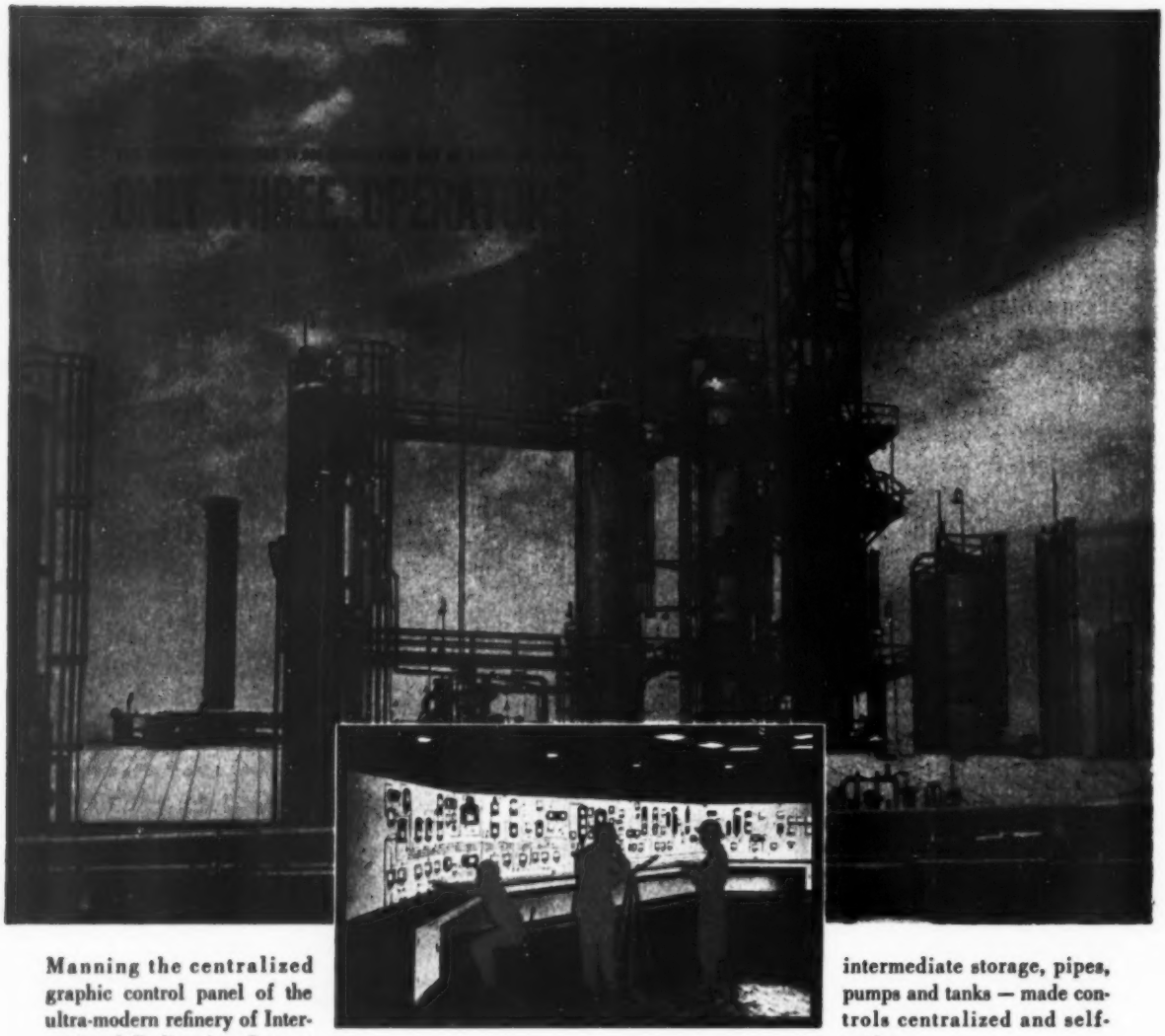


PETROCHEM-ISOFLOW FURNACES

UNLIMITED IN SIZE ... CAPACITY ... DUTY

PETRO-CHEM DEVELOPMENT CO., INC. • 122 East 42nd St., New York 17, N. Y.

Representatives: Bethlehem Supply, Tulsa and Houston • Flagg, Brackett & Durgin, Boston • D. D. Foster, Pittsburgh • Faville-Levally, Chicago • Lester Oberholtz, Los Angeles • Gordon D. Hardin, Louisville • Turbax Equipment Co., Narberth, Pa.



Manning the centralized graphic control panel of the ultra-modern refinery of International Refineries, Inc. at Wrenshall, Minnesota, only three operators per shift completely control the processing of 11,000 B/D of Canadian crude oil.

This outstandingly economical arrangement is indicative of a new concept in refinery design, resulting in a financially profitable small refinery in an area where one had not previously existed.

To meet the special requirements of this situation, we at Lummus combined imagination and process ingenuity with a half century of engineering experience. We integrated Distillation, Model IV Fluid Catalytic Cracking, Gas Recovery, Treating and Catalytic Polymerization into a plant operated as one unit. We made flow of oil continuous, minimizing intermediate storage, pipes, pumps and tanks — made controls centralized and self-acting.

For International, this means a refinery low in initial investment (somewhere around $750 per barrel) and operating costs; one balanced to meet today's needs of the area it serves, but flexible for future changes—a successful solution of their specific problem.

Perhaps this demonstrates how the Lummus approach to a problem may contribute to the success of your next petroleum or chemical project.

THE LUMMUS COMPANY, 385 Madison Avenue, New York 17, N. Y. *Engineering and Sales Offices:* New York, Houston, London, Paris. *Sales Offices:* Chicago, Montreal, Caracas. *Heat Exchanger Plant:* Honesdale, Pa. *Fabricated Piping Plant:* East Chicago, Indiana.

LUMMUS

DESIGNING ENGINEERS AND CONSTRUCTORS FOR THE PETROLEUM AND CHEMICAL INDUSTRIES

NORTHWEST'S FIRST

Continued from page 95

ment plant, which is designed to free waste water of oil, odors or chemicals which may interfere with fishing, oyster culture, bathing or other activities along the U. S. and Canadian shores of the Sound.

The collection system gathers five different types of waste water: oily waste, process waste, chemical waste, sanitary waste and storm drainage. Each type is treated separately in the plant, which consists of collection tanks, separator basins, stripping columns and treating processes.

Operation of the waste water plant will require specially trained operating personnel and qualified chemists who will make control tests on various points within the system. The quality of the water being discharged into the Sound will be constantly checked.

Design of the waste water treatment plant was undertaken as a special project by a group of General Petroleum chemists and engineers as soon as the decision was made to build the refinery. During the design of the unit, consultations were held with the Pollution Control Commission of the State of Washington for suggestions etc.

Cities Service to Build Natural Gasoline Plant

A natural gasoline plant to process casinghead gas produced in the West Seminole field of Gaines County, Texas, will be built by Cities Service Oil Company approximately six miles west of Seminole, Texas, and 20 miles west of Hobbs, N. Mex.

The plant will be built and operated by Cities Service for a group which includes Cities Service as major owner, The Atlantic Refining Company, Burdell Oil Company, Magnolia Petroleum Company, Superior Oil Company, Sinclair Oil & Gas Company, Shell Oil Company, and Great Western Drilling Company.

The plant has been designed to gather and process all west Seminole gas and produce 55,000 gallons daily of natural gasoline and LPG. Delta Engineering Corporation, Houston, will begin construction of the plant right away.

Imperial Taking Bids on Lubricating Oils Plant

Bids will soon be opened for the major part of a $15 million construction program at the Edmonton, Alberta, Canada, refinery of Imperial Oil Ltd. The program will provide western Canada with its first large-scale plant for the manufacture of lubricating oils.

The new lubricating oils plant will be second in size and capacity only to Imperial's Sarnia equipment, which is the largest in Canada. The Edmonton installation will produce about 2000 barrels of high quality automotive and industrial oils a day.

In addition to the new equipment, some of the refinery's existing units will be adapted to provide the raw material for the new plant.

Construction is planned for commencement in the spring of 1954, with completion set for late 1955.

Gulf Gets Approval for Louisiana Cycling Plant

Louisiana Conservation Commissioner John B. Hussey has advised a representative of Gulf Refining Company that unitization of the Krotz Springs gas condensate field in St. Landry Parish, La., and the construction of a cycling plant to serve this field have been approved. The plant will be built and operated by Gulf Refining Company and owned jointly by Gulf, Humble Oil & Refining Company and The Texas Company as originally proposed by Gulf (PETROLEUM REFINER, January, 1953, p. 180).

Construction of the plant has started and is expected to be completed within a year and a half. It is estimated that total investment for plant, additional wells and other facilities required to put the project into full operation will be about $10 million.

Recoveries at the plant will amount to about 27.5 million barrels of condensate, butane and propane.

Burma Oil Completes New Burma Oil Refinery

A new oil refinery recently dedicated at Chauk, Burma, will enable that country to fill more than half of her petroleum needs. The big plant of the British-managed Burma Oil Company is the first built in Burma since World War II. Another refinery is already operating at Syriam.

The new refinery cost about $1,120,000. It has a daily output of 2500 barrels of petroleum products. This will be increased to 4500 barrels when work is completed on another distillation unit being rebuilt.

Who's Building . . .

Indiana Standard Will Build Casper Ultraformer

Addition of a new catalytic Ultraforming unit to its refining facilities at Casper, Wyo., is planned by Standard Oil Company (Indiana). Design of the 3750-barrel-a-day unit is already in the final stages.

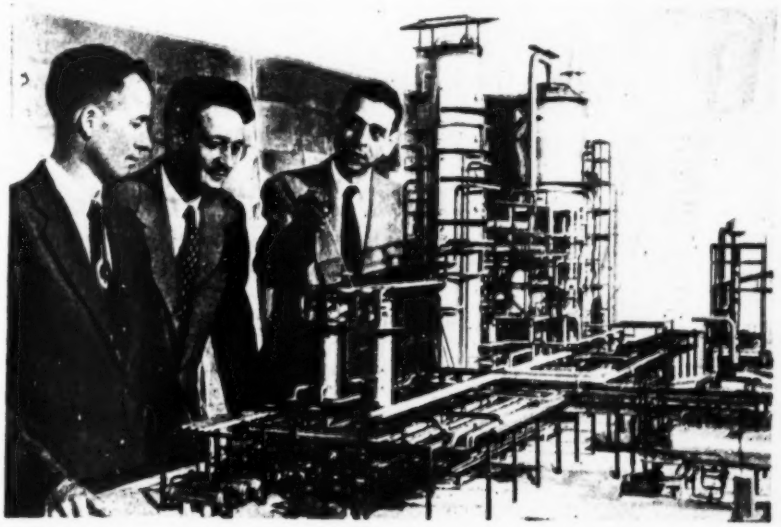
The Lummus Company of New York has been selected as prime contractor and is expected to begin construction in the spring of this year. Completion and initial operation are planned for early 1955.

Other refining units at Casper, including the catalytic cracking unit and facilities built during the expansion and modernization completed in 1949, will continue to operate during construction of the Ultraforming unit. A 700-barrel-a-day alkylation unit now under construction at Casper is scheduled for completion and initial operation in the early summer of 1954.

Offsite tankage and other facilities will also be built to integrate the new Ultraforming unit's operations with the refinery.

East Texas Producers Plan Natural Gasoline Plant

Plans for the construction of a natural gasoline plant in the White Flat oil field, five miles west of Trent in Nolan County, Texas, have been announced. To be built and operated by Payne & Johnston and B. G. Byars, East Texas producers who own the greater part of White Flat production, the plant will



Shell Cat Cracker Built From 3-D Blueprint—

Engineers and field construction workers building the catalytic cracker at Shell Oil Company's Norco, La., refinery have a good idea of what they're working on. They have available what they call a "three-dimensional blueprint," a model, of the cat cracker, 3 feet long, 4 feet wide and 3 feet 4 inches high, built on an exact scale of one-quarter inch to one foot. With a total feed of 72,000 barrels a day, the Norco cat cracker will be Shell's biggest and one of the largest in the world when completed next year.

Builder of the model is H. H. Wanderman, who is shown above pointing out some of its features to H. E. Henslee, left, of Foster Wheeler Corporation, builders of the unit, and H. L. Isham, a Shell engineer.

AIR • GAS • AMMONIA / compressor operators

DID YOU KNOW...

you can build peak performance into your oldest compressors!

and obviously into your newer, high speed machines, too!

INSTALLATION OF VOSS VALVES WILL DO THE JOB!

if you want peak performance . . . increased efficiency . . . greater output . . . lower power costs with utmost safety, investigate the advantages of VOSS VALVES for your machines.

VOSS VALVES provide. . . Quiet, vibration-free operation • 20 to 60% more valve area • less power consumption • low pressure loss • normal discharge temperature • lower operating costs • utmost safety.

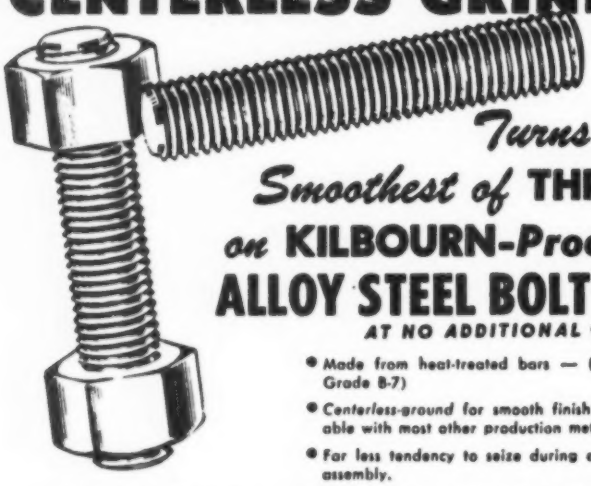
To increase the efficiency of your compressor, send us the name, bore, stroke and speed of your machine. Our detailed proposal will be sent without obligation.

VOSS VALVES
REG. U.S. PAT. OFF.

J. H. H. VOSS CO.
INCORPORATED

784-A East 144th Street, New York 54, N. Y.

CENTERLESS GRINDING



Turns Out Smoothest of THREADS *on* KILBOURN-*Processed*
ALLOY STEEL BOLT STUDS
AT NO ADDITIONAL COST

- Made from heat-treated bars — (A.S.T.M. A193 Grade B-7)
- Centerless-ground for smooth finish — not obtainable with most other production methods.
- Far less tendency to seize during assembly or disassembly.
- Preferred by refineries, chemical plants, power plants, pipeline installations.

Write for Bulletin

KILBOURN® Engineering Company, Inc.

5102 N. 35th St., Milwaukee 9, Wisc.

STUDS • THREADED BARS • STILL SCREWS • STAINLESS STUDS AND NUTS

Who's Building...

have a daily capacity of about 8 to 10 Mmcf. Products of the plant will be butane, propane and natural gasoline.

Tide Water Will Build Processing Unit at Avon

A new multimilion dollar oil processing unit will be built by Tide Water Associated Oil Company at its Avon, Calif., refinery. Site clearing for building the new "hydrocarbon Platforming" plant and auxiliary equipment will begin soon, with completion of construction scheduled for the end of the year. The new unit will have a capacity of 10,000 barrels a day of high-octane gasoline components.

A by-product of the process employed in the unit will be hydrogen sulfide gas in substantial quantities. This gas will be retained and used as an additional source of supply in making sulfuric acid at the adjoining plant owned jointly by Tide Water and Monsanto Chemical Company.

The new plant will be basically a two-unit operation. The first catalytic process will remove over 90 percent of the natural sulfur and other impurities in the naphthas which are treated in it. The second is a platforming unit.

C. F. Braun Company of Alhambra, Calif., has been awarded the construction contract under license arrangements with Universal Oil Products Company.

Esso Gets Top Write-Off for New Bayway Units

Esso Standard Oil Company has been granted rapid tax write-off on its $14.9 million refinery project at Bayway, N. J., to lead the latest list of projects approved by the Office of Defense Mobilization. Esso's plans call for a 60,000-barrel-a-day crude still and a 21,500-barrel-a-day fuel oil processing unit, together with utilities and auxiliaries. Esso Stanlard was granted 55 percent write-off on $11,671,000 basic refining units and 45 percent on $3,243,600 auxiliary facilities.

Other projects approved by ODM for fast write-off:

Additional units for Westoil Terminals Company's previously approved plans for catalytic cracking and polymerization facilities at its San Pedro, Calif., refinery—$600,000 at 65 percent.

Phillips Petroleum Company's petroleum refining facilities at Phillips, Texas —15 to 65 percent of portions of $2,577,000.

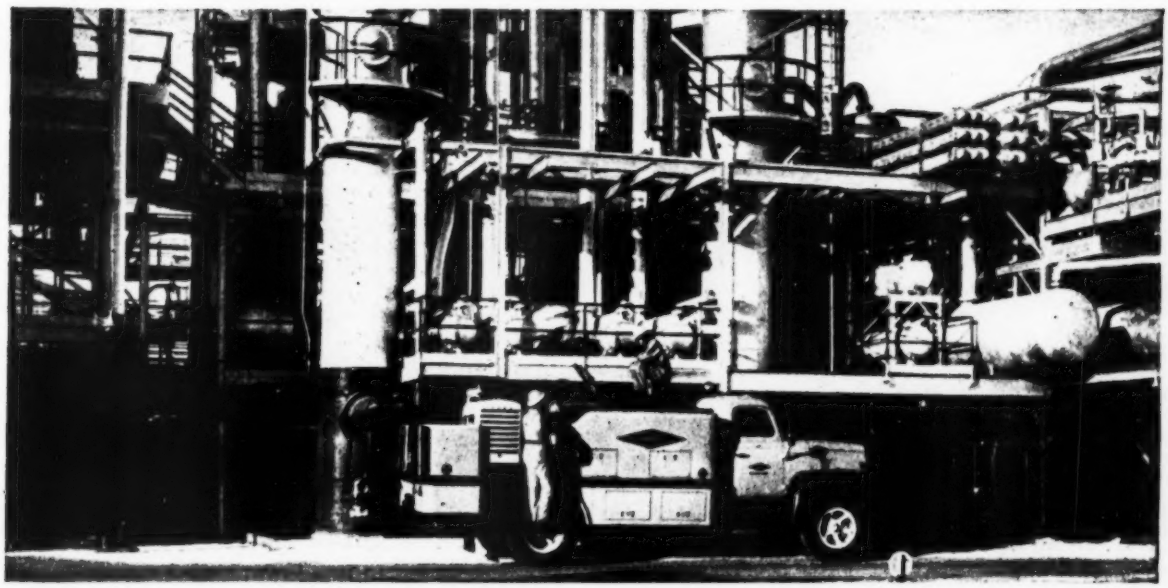
Signal Oil & Gas Company's natural gasoline facilities at Fox, Okla.—40 to 65 percent of portions of $2,945,000.

Intercol Refinery Plan Gets Colombian Approval

The proposal of International Petroleum Company (Colombia), Ltd., to build a new refinery on the Carribbean Coast has been accepted by the Colombian government. To cost an estimated $35 million, the plant would most likely be built near Cartagena, which is the

TOWER CAPACITY RESTORED IN ONE DAY BY CHEMICAL CLEANING

Through-put increased from 500 to 800 gallons per minute by Dowell Service



The capacity of a fractionating bubble-cap tower, operated by a southern chemical company, had dropped from 800 to 500 gallons per minute. Heavy deposits covered the traps and clogged the bubble-caps. Dowell engineers analyzed these deposits and found them to be iron sulphides, oxides and organic material.

Dowell Service removed these deposits from the tower in only one day with specially prepared liquid solvents. Result: the tower was restored to its original 800 g.p.m. capacity.

In the Dowell method of chemical cleaning, solvents are applied according to the technique demanded by the job: filling, spraying, jetting, cascading or vaporizing. Being liquid, they will go wherever steam or water will flow, reaching surfaces inaccessible to other cleaning methods. No special scaffolding is required. Dismantling and downtime are kept to a minimum. Experienced Dowell engineers do the job for you using Dowell-designed pump trucks and control equipment which are brought right into your plant.

Towers are just one of hundreds of pieces of industrial equipment which can be cleaned chemically by Dowell Service. For complete information and estimates on the cleaning of your equipment, call the nearest Dowell office, or write directly to Tulsa, Dept. B31.

DOWELL SERVICE

Over 100 Offices to Serve You with Chemical Cleaning for:

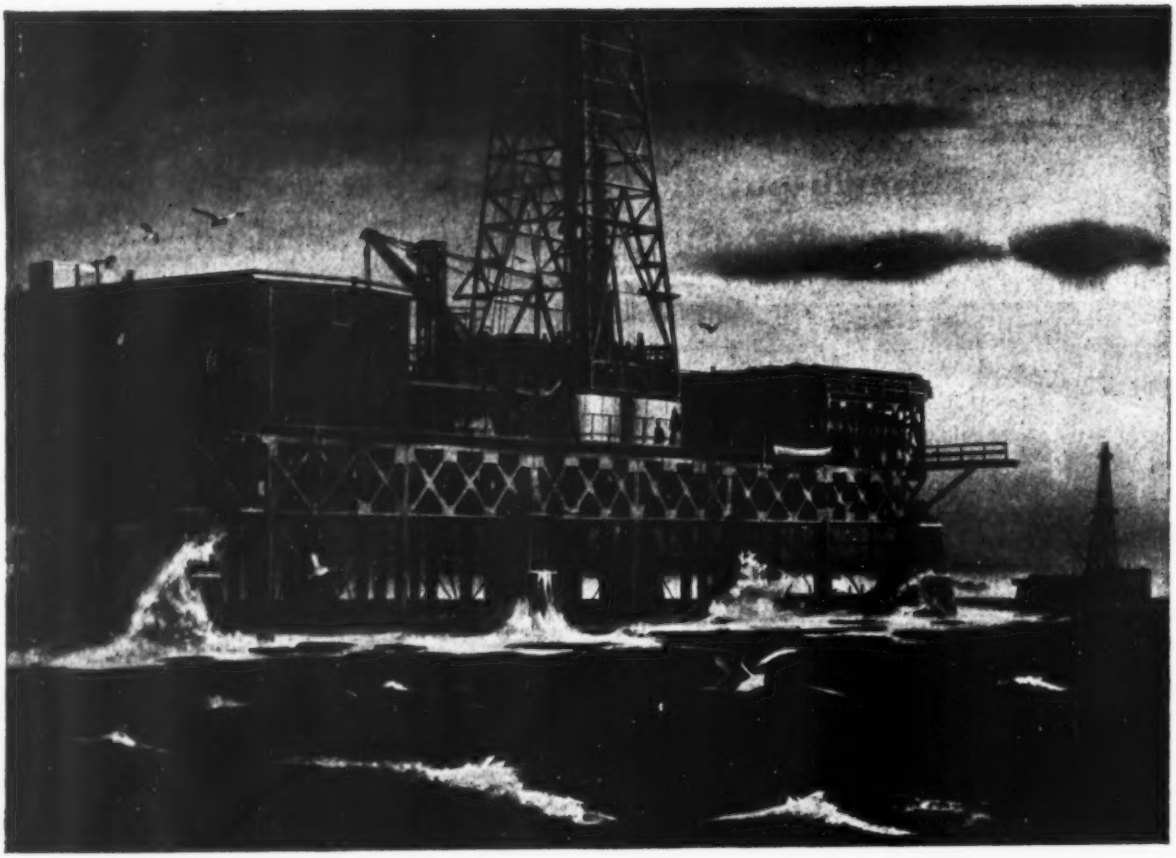
Boilers • Condensers • Heat Exchangers • Cooling Systems
Pipe Lines • Piping Systems • Gas Washers • Process Towers
Process Equipment • Evaporators • Filter Beds • Tanks

Chemical Services for Oil, Gas and Water Wells

DOWELL INCORPORATED · TULSA 1, OKLAHOMA

DOWELL

A Service Subsidiary of
THE DOW CHEMICAL COMPANY



OVER OR UNDER...LAND OR SEA...BROWN & ROOT'S EXPERIENCE CAN SAVE YOU MONEY . . . TIME!

Four decades of diversified experience in heavy construction and engineering has developed a "know-how" for Brown & Root which can be invaluable to you. Over the years Brown & Root's technological developments have provided important savings of time and money for many clients.

Regardless of your interest, be it in finished products—fabricated parts or basic materials Brown & Root can help you. Centralized responsibility coordinates engineering and construction. This plus loyal personnel will save your firm time . . . money.

If your company contemplates new construction or plant expansion a call from you will place Brown & Root plant planning experts at your disposal.

BROWN-BILT

BROWN & ROOT, Inc. *Engineers • Constructors*

P. O. BOX 3, HOUSTON 1, TEXAS

CABLE ADDRESS — BROWNBILT

Associate Companies:— BROWN ENGINEERING CORP. • BROWN & ROOT MARINE OPERATORS INC.

terminal of the Andian National pipe line carrying crude from the de Mares and Casabe fields.

The proposed project calls for a 25,000-barrel-a-day refinery to meet the requirements in both the Atlantic and Pacific Coast sections of Colombia. These areas are now supplied by imports since Colombia's refineries are all located in the interior without ready access to coastal markets.

Japanese Refiners Put Platformers on Stream

First UOP Platforming units to be installed in the Far East have gone on stream at two Japanese refineries. One unit is at Koa Oil Company, Ltd., Marifu, with a design capacity of 1300 barrels a day. The other unit is at the refinery of Nippon Petroleum Refining Company, Ltd., also with a capacity of 1300 barrels a day. Both companies are associated with Caltex.

Sunray Begins Work on New Platforming Unit

Preliminary grading and site preparation has been completed and foundation work begun on the new UOP Platforming unit which Sunray Oil Corporation is building in conjunction with its catalytic cracking refinery at Sunray Village, Duncan, Okla.

Construction is being handled by Refinery Engineering Company, Tulsa. Universal Oil Products designed the catalytic reformer for 5000 barrels a day of thruput. Engineering work on the Platformer is being done by Mechanical Design, Inc.

Approximately ten months will be required to complete engineering and construction on the new Platformer.

Semet-Solvay Starts Up New Polyethylene Plant

Production of polyethylene products has started at the Niagara River petrochemical plant of the Semet-Solvay Petrochemicals division of Allied Chemical & Dye Corporation. The plant is located at Tonawanda, N. Y.

Ethylene is derived from gas which is produced from fuel oil in equipment design and erected by Semet-Solvay Engineering division. This is an innovation in the petrochemical industry as most plants have been built near natural gas lines.

Lummus Company designed and constructed the ethylene plant, while Semet-Solvay engineers designed the plant for production of polyethylene.

Payne & Johnston, Byars to Start on Gasoline Unit

Construction is expected to start right away on a proposed natural gasoline plant in White Flat pool located in northeastern Nolan County, Texas. The plant will be built and operated by Payne & Johnston and B. G. Byars, East Texas producers who own a major part of the production in the pool. The new installation will process between 8 and 10 Mmcf of gas daily and will produce butane, propane and natural gasoline.

Yugoslavia Schedules Refinery Construction

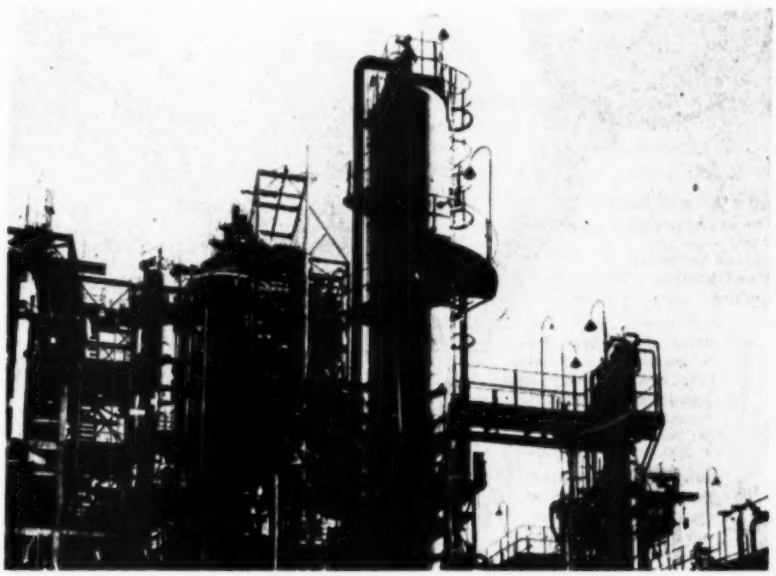
The Yugoslav government has developed a program for investment of capital in the construction of new State controlled oil refineries. Under the program a 500,000-ton-year crude processing plant will be built at Sussak, east of Rjeka (Fiume). For this project machinery is to be supplied by West German engineering industries. Another 600,000-ton-a-year crude processing plant is to be built at Zagreb and another of the same capacity in Belgrade. The latter is to be operated by a Yugoslave-Romanian-Russian State concern which is to be created within the provisions of the Yugoslav-Russian trade agreement.

Who's Building. . .

Houston Oil Man Plans Big Wyoming Gas Plant

Plans for a $4.5 million gas plant in the field of Weston County, Wyo., have been announced by Lucien Cullen, Houston oil man. A group of Houston investors, including Cullen, will finance the venture.

Tentative plans, Cullen said, call for a plant to process 30 Mmcf of gas daily, with operators who furnish the gas guaranteed 25 percent of the sales price of the refined products, or a minimum of 5 cents per 1000 feet of gas. The site would be west of Newcastle.



Atlantic Completes First Step in Modernization—

This new Catforming unit which The Atlantic Refining Company recently put on stream at its Philadelphia refinery is the first such unit on the East Coast. Completion of new unit marks the completion of the initial phase of a $50 million modernization program at the refinery. The Catformer has a capacity of 500,000 gallons of high-octane gasoline daily.

Now being constructed as part of the modernization are a synthetic ammonia plant, a catalytic cracking unit which will be the largest of its type in the world, a large distillation unit with a capacity of 50,000 barrels of crude oil a day and an aviation alkylate unit.

Construction Capsules

Pan American Refining Corporation has begun construction of a 21,000-barrel-a-day Ultraforming unit at its Texas City, Texas, refinery. The contractor is The M. W. Kellogg Company. Ultraforming is a new catalytic reforming process developed by Standard Oil Company (Indiana).

•

Phillips Petroleum Company has almost doubled its production of anhydrous ammonia with start-up of a new 450-ton-a-day plant recently completed by Phillips Chemical Company, a wholly owned subsidiary, at Adams Terminal on the Houston Ship Channel. Also being put into operation at Adams Terminal is a new 405-ton-a-day triple superphosphate fertilizer plant. At the same time new additions to Phillips' plant at Dumas in the Texas Panhandle more than double the production of nitric acid used in the manufacture of ammonium nitrate in its plants there.

•

The Texas Company has awarded a contract to James P. O'Donnell, Engineers, New York, for the structural and piping design of a new alkylation plant to be erected at Texaco's Eagle Point refinery at Westville, N. J. The process design of the 2000-barrel-a-day plant is being handled by Texaco.

•

Skelly Oil Company will install a 7500-barrel-a-day catalytic reformer at its El Dorado, Kan., refinery. Licensing arrangements have been completed with Universal Oil Products Company.

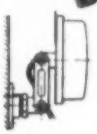
PALMER
MERCURY ACTUATED

DIAL THERMOMETERS

in 3 types to suit any requirements

Full 4½" dial face. Stem can be placed at any angle and case can be rotated to any readable position.

1 **Rigid Stem Dial Thermometer** tapered bulb, interchangeable with standard industrial thermometer separable socket. (As illustrated above.)



2 **Wall Mounted Dial Thermometer** with flexible connecting armor. Case adjustable to easy reading position.

3 **Flush Mounted Dial Thermometer** for panel mounting with flexible connecting armor.

All three types have a full 4½" dial face.

for accuracy: Mercury actuated . . . Fully Compensated by Invar Compensaton. Guaranteed Accurate 1 scale division.

for angularity: Can be adjusted to most readable position at any angle desired.

for readability: Bold Black Numbers . . . 11" of scale Reading Dial face can always be placed in easiest readable position.

for interchangeability: Always specify "PALMER" Separable sockets as they are interchangeable for Dial or Industrial type Thermometers.

Send for Bulletin 31-129 for details on the New Palmer Dial Thermometer.

PALMER
THERMOMETERS, INC.
Norwood Ave. Cincinnati 12, Ohio
Mfrs. of Industrial Laboratory Regarding and Dial Thermometers

Who's Building . . .

The Dow Chemical Company has completed a plant for the manufacture of vinyltoluene at Midland, Mich., and the plant is now in full production. The production plant is composed of alkylation, cracking and finishing units.

•

Suntide Refining Company has put all remaining units of its new $20 million Corpus Christi, Texas, refinery into operation. Other units of the 30,000-barrel-a-day plant went on stream last August, about one year after construction of the plant was started by the Lummus Company.

•

Petroleos Mexicanos, Mexico's oil monopoly, has been given a budget for the current year of $11,630,000 for construction of refineries. The agency's Minatitlan refinery will account for half of this sum while the modernization of the Ciudad Madero refinery and a new absorption plant in Reynosa will require the balance of the money. The Reynosa unit will be capable of handling approximately 8.5 Mmcf of gas.

•

Petroleum and Chemical Corporation (Australia), Ltd., a new company, plans to build a petrochemical plant at Silverwater, near Sydney, Australia. American private investors are reported to be among backers of the venture which will have an initial capital of $7 million. Feed stock for the installation will be obtained from Bitumen and Oil Refineries (Australia), Ltd.

•

Monsanto Chemicals (Australia), Ltd., Monsanto Chemical Company's Australian associate, has started production of phthalyl sulfacetamide at its new plant in Australia. It has also started production of polystyrene from imported styrene monomer.

•

Husky Oil Company has completed a $1 million improvement and modernization program at its Cody, Wyo., refinery. Most recent unit to go on stream was a 6000-barrel-a-day vacuum unit.

•

American Cyanamid Company has doubled the originally planned production capacity of the anhydrous ammonia plant that it is building near New Orleans. The plant, now to have a capacity of 300 tons a day, will cost $50 million. In addition to producing anhydrous ammonia, the plant will manufacture acetylene, hydrocyanic acid and such derivatives as acrylonitrile and ammonia sulfate.

•

Republic Oil Refining Company has put on stream a 5500-barrel-a-day UOP Platforming unit at its Texas City, Texas, refinery. The unit was developed, designed and licensed by Universal Products Company. Construction of the Platformer was handled by Procon, Inc.

•

Allby Asphalt and Refining Corporation has scheduled the start-up of its new asphalt refinery at Hammond, Ind., for next month. The plant is being built by Byerlyte Corporation, Cleveland, and Allied Materials Corporation, Oklahoma City, Okla.

•

Lion Oil Company has placed in opera-

PROTECT your boiler investment

Follow this simple gauge glass rule...

1 for the gauge and 2 for the shelf

The small investment in space and pennies that you put into buying two spare gauge glasses will be repaid a hundred times in:

- Fast glass replacements at regular intervals—for maximum gauge safety.
- An extra spare for quick glass replacement in emergencies.
- Assurance that you can get the *type* of gauge glass you want—the instant you want it.
- Round-the-clock assurance against damage through gauge failure.

CORNING INDUSTRIAL GLASSWARE FOR EVERY JOB

Application	Recommended Product
Normal Conditions (Up to 100 p.s.i.)	CORNING brand standard gauge glasses
Higher temperatures	PYREX brand high-pressure gauge glasses
Higher pressures	PYREX brand heavy-wall gauge glasses
Extra visibility	PYREX brand red-line gauge glasses
Viewing inside furnaces, reactors pressure vessels, etc.	PYREX brand sight glasses
Lubrication Inspection	PYREX brand lubricator glasses
Visible discharge devices	PYREX brand oil cup glasses

Start this new protection today! Order two spare gauge glasses for every boiler in your plant!

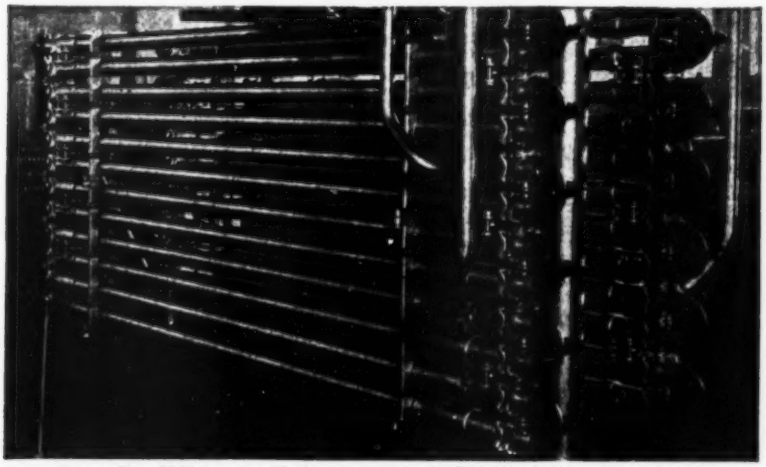
Call your Industrial Distributor NOW!

TM REG PYREX US PAT OFF

CORNING GLASS WORKS
Corning, New York

Corning means research in Glass

BRIDGEPORT BRASS COMPANY
CONDENSER AND HEAT EXCHANGER TUBE EDITION
COPPER ALLOY BULLETIN
Bridgeport MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND. — IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL



Ammonia-type Beer Chiller—outer 3" pipes of steel; inner 2" Duplex Tubing with steel over copper. Beer is circulated through copper circuit. Courtesy The Vilter Manufacturing Co., Milwaukee, Wis.

Copper and its Alloys Increase Service Life of Refrigeration Systems

Mechanical refrigeration has grown very rapidly and has deeply penetrated industrial, processing, chemical, refining and domestic fields.

Since refrigeration systems involve many miles of tubing which must handle corrosive liquids, gases, or cooling waters, the selection of tube alloys capable of standing up under severe service conditions is one of the most fundamental problems confronting the engineer. In this field copper-base alloys are predominantly used because they have proven very satisfactory.

Freon and Methyl Chloride Refrigerants

Where refrigerants such as Freon or methyl chloride are used, Copper, Red Brass, Admiralty, Aluminum Brass, Aluminum Bronze and the Cupro Nickel alloys are corrosion resistant and give long life. The selection of the proper alloy depends upon the cooling water, brine, or product.

Ammonia Refrigeration

The good corrosion resistance of steels to ammonia, both gaseous and liquid, explains their wide use in the construction of equipment handling ammonia. However, steel tubes and pipes are subject to corrosion from brine, sea water or fresh water. This shortcoming can easily be overcome through the use of Duplex Tubing, consisting of copper or copper-base alloy to the water side and steel to the ammonia side. This combination is finding wide application not only for ammonia refrigeration, but also for equipment producing ammonia and its compounds.

The most popular combinations are low carbon steel with Copper, Admiralty, or Red Brass for handling fresh water from rivers, lakes, ponds, and wells. Where sea water is used for cooling purposes, Cupro Nickel, Duronze IV (arsenical aluminum bronze), Aluminum Brass, and Admiralty are preferred because of their greater corrosion resistance.

Corrosion by Brine

In general, copper and its alloys stand up very satisfactorily handling cooling brines. Where general or localized corrosion occurs, it is usually due to the presence of other substances in the brine. For example, ammonia contamination may lead to corrosion cracking of stressed yellow brasses.

Corrosive Atmospheres

Where air is being cooled, the moisture in the air is precipitated on the cool surface of the tubes. Such condensate may absorb corrosive gases and salts which are destructive to ferrous metals. Copper and its alloys generally withstand this type of corrosion very satisfactorily.

Where air instead of water is cooling the refrigerant, copper and its alloys give excellent service.

Circulating Fresh Water

For fresh water, Copper is very widely used. Admiralty and Red Brass are also in common use, the Admiralty being preferred where sulfides are present in the cooling water.

Circulating Sea Water

For sea water at velocities of 5 to 6 ft. per second, Arsenical Admiralty stands up well. Where the velocities exceed this speed, impingement corrosion may be encountered in Admiralty tubing. Under these conditions Aluminum Brass, Cupro Nickel or Duronze IV should be used because of their superior resistance to impingement.

Product Corrosion

For handling beverages, chemicals, liquids, or gases, the selection of the most suitable metal depends upon the nature of the product handled. For many applications, copper and its alloys are very satisfactory. For special cases involving the handling of liquids or gases corrosive to copper, or where product contamination by traces of copper is undesirable, Duplex Tubing consisting of Aluminum, Low Carbon Steel, Stainless, etc., combined with Copper and its alloys often give excellent service.

Laboratory Service

Bridgeport corrosion metallurgists have been helpful in recommending Duplex Tubing combinations which have led to improved operating efficiencies. Not only has tube life been greatly extended but lower maintenance has resulted. Contact your nearest Bridgeport office for help on your metal problems and for your tube requirements. (1338)

TWO TERRY TURBINES IN RECORD NON-STOP RUN AT CITIES SERVICE

After 26 Months of Continuous Operation, Cost of Replacement Parts Only $78.00 for Each Turbine

Two Terry turbines recently completed a record non-stop run at the East Chicago refinery of Cities Service Oil Company. Specially designed for driving air blowers on fluid catalytic cracking, they ran continuously *from initial start up*, day and night, for two years and two months. Throughout the entire run neither turbine suffered any noticeable reduction in efficiency.

On inspection, after shutdown, it was found that the only parts showing signs of wear were the shaft packing rings. These were replaced at a total cost of $78.00 for each turbine.

While this extremely low cost for repairs, after such a record run, could not have been anticipated, Cities Service had good reason to expect outstanding performance from Terry turbines. A four-year record of 216 Terry turbines at the Lake Charles refinery of this same company showed amazingly low maintenance costs. During this period, the yearly cost of replacement parts averaged only 1.4% of the initial investment.

The two turbines at East Chicago are rated 2450 horsepower at 5030 rpm. Each is equipped with a trip throttle valve, forced feed lubrication, and regulator for process control applied to a variable speed oil relay governor.

For more information about Terry multistage turbines, send for a copy of Bulletin S-146. No cost or obligation.

TERRY

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TT 1193

Who's Building...

tion its new refinery facilities at El Dorado, Ark. Constructed at a cost of about $5.5 million, the new installations include a Model 4 fluid catalytic cracking unit, vapor recovery unit, alkylation plant, de-ethanizer unit, additional steam generating units and new product storage tanks. Lummus Company designed and constructed the plant additions.

•

Union Oil Company of California has taken a five-year option to purchase 700 acres of land adiacent to the eastern boundary of its Oleum, Calif., refinery for possible future expansion of facilities. The refinery's present available acreage will have been largely used up upon completion of the units now under construction at Oleum.

•

Sinclair Refining Company and **Consolidated Chemical Industries, Inc.,** plan to give air pollution abatement a boost in Houston area by cutting the escape of sulfur dioxide fumes. Sinclair will install facilities to recover heavy acid sludge. Consolidated will build a $3.5 million plant to burn this sludge for production of sulfuric acid. Sinclair will also build a sulfur recovery plant.

•

Compagnie de Raffinage Shell-Berre is producing sulfur from natural gas for the first time in France at its Berre-l'Etang refinery. Expected production is between 4000 and 5000 tons this year.

•

Jordanian Reconstruction Council has decided to erect a $7.5 million refinery in Jordan to refine the country's share of crude oil from Tapline. Technical details will be prepared by the council and sent to the International bank for Reconstruction and Development preparatory to a loan request. The proposed refinery is expected to be located at Mafrak.

•

Prime Oil Company, a division of Wood River Oil & Refining Company, Wichita, Kan., will erect a $10 million refinery on a 155-acre tract in Calumet City, Ill. The plant's capacity will be 15,000 barrels a day.

•

S. A. Tecnico—Industriale, "Aquila," petroleum refinery at Trieste, has been granted a $2,012,500 loan by the Allied Military Government to be used in the construction of a $4,025,000 refinery.

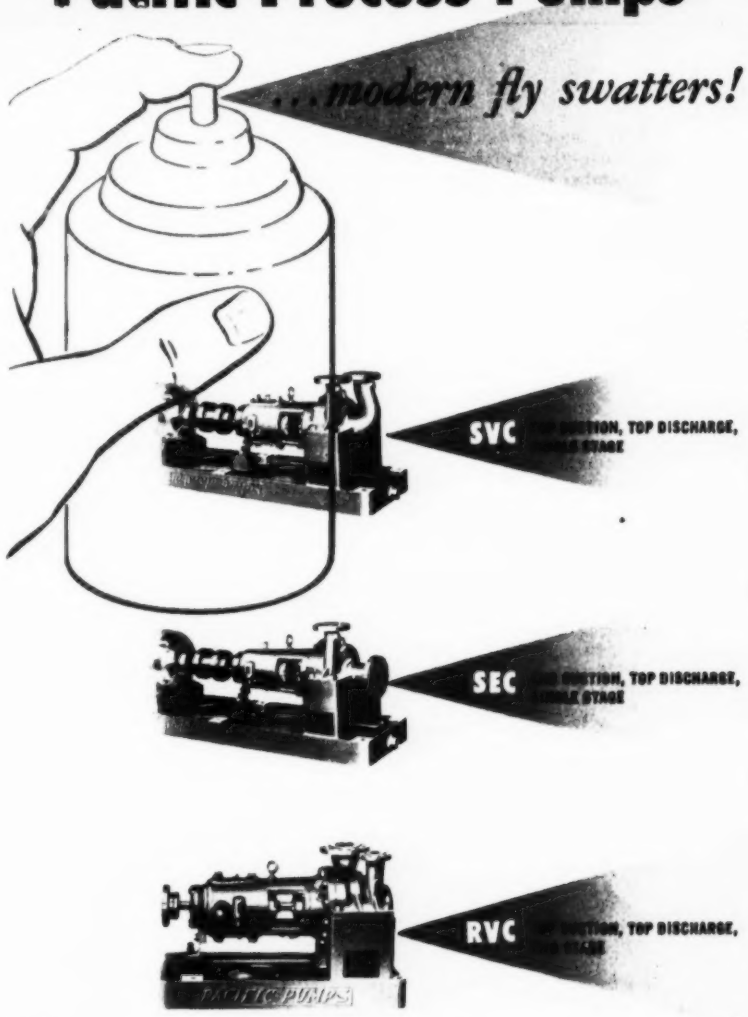
Crown Central to Install $1 Million Houdriformer

Work is scheduled to start immediately on a 5000-barrel-a-day Houdriformer at Crown Central Petroleum Corporation's Pasadena, Texas, refinery.

The Houdriformer will be an addition to Crown Central's refinery on the Houston Ship Channel at Pasadena. It will handle typical stocks processed in Gulf coast refineries and will incorporate facilities for the complete conditioning of charged stocks prior to reforming.

The basic process designs were furnished by Houdry Process Corporation. Contract for the construction of the catalytic reformer and other facilities was awarded to Blaw-Knox Company. Completion is scheduled for October.

Pacific Process Pumps



★ Custom fabricated from properly chosen materials to perform their tough jobs, Pacific process pumps give a mighty assist in the production of insect sprays, detergents, antiseptics and a host of other products that safeguard health and give comfort to mankind . . . thus in a sense becoming "modern fly swatters." The widespread use of Pacific process pumps for heavy-duty assignments in the petro-chemical industry is conclusive proof of Pacific's ability to perform continuous service with sustained economy.

Pacific single-stage Types SVC and SEC handle liquids from sub-zero to 800°F., 15 to 1,600 gpm, 500 to 600 psig, discharge pressure, differential heads up to 600 feet, speeds to 4,000 rpm. Two-stage Type RVC pumps liquids from sub-zero to 850°F., 50 to 600 gpm, discharge pressure to 600 psig, differential heads to 825 feet, speeds to 3,600 rpm. For further details, write for Bulletins 101 and 108.

PACIFIC *Precision Built* PUMPS

Pacific Pumps inc.

HUNTINGTON PARK, CALIFORNIA

Export Office: Chanin Bldg., 122 E. 42nd St., New York

Offices in All Principal Cities

CP-9

Who's Meeting . . .

SAE

One of today's most important automotive problems—the formation of combustion chamber deposits in the engine and the resultant demand of the engine for higher octane gasoline—was discussed at the annual meeting of the Society of Automotive Engineers, January 11-14, Detroit. To alleviate the problem, two approaches were considered: gasoline additives and improvements in motor oils.

Gasoline Additives

Dr. C. O. Tongberg, Standard Oil Development Company, discussed the gasoline additive approach to combustion chamber deposits. Extensive car surveys and controlled field and laboratory engine tests indicate that the major problem resulting from combustion chamber deposits is octane requirement increase, and that neither preignition nor spark plug fouling is critical in present day cars. Less than seven percent of all cars on the road today could have a preignition problem, and most of them would not experience the problem if a high octane premium gasoline were used.

Means of eliminating these deposits or minimizing their harmful effects through changes in the make-up of the gasoline and lubricating oil, and by the use of gasoline additives, are under study by petroleum research laboratories. A variety of gasoline additives have been investigated by the authors. These include combustion catalysts, designed to promote removal of the deposits by combustion; deposit modifiers, intended to convert the deposits to a less harmful form; and solvation agents, intended to remove the deposits by a solvent or fluxing action.

The combustion catalysts studied included chromium and cobalt compounds. These materials had essentially no effect in preventing octane requirement increase, the most serious problem associated with the combustion chamber deposits.

Tricresyl phosphate, a readily available additive of the deposit modifier type, has been studied. Based on a large number of engine tests, tricresyl phosphate in a base fuel has been found to give (1) more control of preignition; (2) higher ultimate engine octane requirements; and (3) slightly greater loss of power and poorer fuel economy, when compared with the base fuel alone. Overall, the disadvantages of tricresyl phosphate appear to more than offset its benefit with respect to preignition, particularly since preignition does not appear to be serious in today's cars.

In further experiments, some beneficial effect on octane requirement increase was observed with certain solvation type additives. These included high boiling, fluorine-containing organic chemicals.

Further intensive research toward solving the combustion chamber deposit problem can be expected, particularly since this problem may be more serious in future-design engines.

Tricresyl Phosphate

R. J. Greenshields, director of Shell Oil Company's Wood River, Ill., research laboratory, cited reports of tests made by Sun Oil Company, General Motors, E. I. du Pont de Nemours and Company and independent research organizations, as well as Shell, indicating the seriousness of preignition and spark plug fouling caused by lead deposits.

He said a very severe road test on eight new 1952 cars under city driving conditions conducted by the Southwest Research Institute showed that cars using tricresyl phosphate went 170 to 250 percent farther than cars using ordinary fuel before spark plug fouling began. Two of the cars that had been fouled in the test with ordinary gasoline were run on the same schedule for 300 miles using gasoline with tricresyl phosphate and both regained 60 percent of the acceleration performance that had been lost.

Concerning power loss from spark plug misfiring, Greenshields said that in a Shell Oil laboratory test a typical engine that had been fouled using regular gasoline had only 87 percent of new spark plug power, but after eight hours of operation with fuel containing tricresyl phosphate the power was back at 98.5 percent of new plug power.

Lubricant Composition

Dr. L. E. Moody, Standard Oil Development, discussed the effect of lubricant composition on combustion chamber deposits. Conventional motor oils are usually prepared by blending a thick, viscous component (bright stock) with a thinner oil (distillate). However, to prepare an improved motor oil—one which does not contribute to combustion chamber deposits—it was found necessary to eliminate the thick components (all of the bright stock and some of the distillate). The crude oil source and the types of hydrocarbons present in the motor oil do not seem to affect combustion cleanliness.

With the thick components removed, the remaining distillate base oil requires an additive thickening agent so that the finished motor oil will give low oil consumption. This additive, of course, must not contribute to the formation of combustion chamber deposits. A non-contributing thickening agent, which also imparts other valuable properties to the oil, is readily available.

Other additives are commonly used in motor oils to give them good detergency and to inhibit deterioration during use. A detergent-inhibitor additive which is wholly non-contributing to combustion deposits has not yet been found. Still, by careful selection of the optimum concentration and type of additive, presently known detergent-inhibi-

IDEAL
WIEDEKE Precision-Built Tube Expanders
No. 235 for average Sheets
Ball Bearing Adjustable Thrust Collar Tube Expanders are made for Tubes ¼" diameter and larger.
Recommended for use with any Controlled Rolling Motor for uniform expansion of Tubes.
See your Dealer or write us for Bulletin.
For Rolling—Heat Exchanger, Condenser and other Heat-Transfer Tubes.
No. 270—For thick or multiple Sheets.
THE GUSTAV WIEDEKE COMPANY
DAYTON 1, OHIO

REPUBLIC ALLOY STEEL STUDS

KEEP PRESSURES LOCKED IN TIGHT

● On shut-off valves, headers, pressure vessels, on all high-pressure refinery equipment Republic Alloy Steel Studs provide maximum holding power. Keep pressures locked in tight.

Clean, accurate threads for full engaged-thread area plus dependable Republic Alloy Steels assure you of maximum service . . . even under the most severe pressure, heat and corrosive conditions. Specify Republic Alloy Steel Studs for new pressure vessels. Carry them in stock for replacements.

REPUBLIC STEEL CORPORATION
Bolt and Nut Division • Cleveland 13, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, N.Y.

REPUBLIC BOLTS AND NUTS

Other Republic Products include: Bolts, Studs, Nuts and Rivets—Pipe—Sheets—Plates—Electrunite Heat Exchanger Tubes

NEW, ECONOMICAL LININGS CONTROL EROSION and SEEPAGE

Chetumal, Mexico

Industrial Reservoir

Harris Reservoir

WITH more than one million square feet now in use, field proven GULF-SEAL Prefabricated Asphalt Lining provides an enduring answer to erosion and seepage problems, and at a significantly low cost.

Before releasing these linings to Industry, for the control and elimination of water seepage and erosion in reservoirs and industrial waterways, the linings underwent extensive testing in nationally-known laboratories. Additionally, installations were laid down in many parts of the country to obtain complete data on the performance of these linings under varying climatic and soil conditions.

Uniformly encouraging results emerged from these field and laboratory tests, confirming the durability, stability, and longevity of GULF-SEAL linings. We recommend them for your serious consideration most sincerely.

Extraordinarily complete technical data is conveniently available to you, including full-color movies showing a broad cross-section of installations. Our catalog, which is just off the press, will provide you with valuable original material in the evaluation of these linings.

We will be happy to mail your copy to you.

Gulf-Seal

Pat. Pend. ©

SPECIFCATIONS

Size of Sheet: One-half inch thick, three feet wide, and any convenient length . . . **Joints:** Made with special mastic, supplied with order. Long sides are lapped 3", ends, 6". Alternate: ends and sides may be butted, with either 4" overlay or underlay strip. **Materials:** Specially processed & formulated asphalt base mastic, in which are incorporated selected fillers and fibres for additional strength and durability, covered by felt sheets top and bottom which are then treated to increase longevity of lining.

(Complete Specifications are contained in Catalog.)

WRITE TODAY FOR CATALOG

A PRODUCT SPECIFICALLY ENGINEERED FOR THE PETROLEUM, NATURAL GAS AND PETRO-CHEMICAL INDUSTRIES

GULF STATES ASPHALT COMPANY

POSTOFFICE DRAWER 508 • SOUTH HOUSTON, TEXAS • HUDSON 6-7195

tors may be used in formulating improved motor oils.

Based on the results of this work, an improved commercial motor oil has been formulated with low combustion chamber deposit and octane requirement increase properties. Used in combination with a commercial leaded gasoline, the improved oil shows as much as a four octane number advantage over a conventional motor oil. That is, to prevent knocking after the first few thousand miles, a car operating on the improved oil could use a gasoline four octane numbers lower than that required by a car using a conventional motor oil.

While much progress has been made in reducing octane requirements through better motor oils, there is still much room for improvements.

Crankcase Oil

R. L. Overcash, W. Hart and D. J. McClure, Kendall Refining Company, discussed crankcase oil as an approach to the problem of combustion chamber deposit. Many of today's engines present no real problem in performing satisfactorily with present fuels and lubricants. However, knocking and preingnition complaints have reached quite serious proportions in some cars due to the accumulation of deposits in the combustion chamber. This paper reports only on the reduction of combustion chamber deposits through the use of specially formulated crankcase oils, although fuels, engine design and operating conditions are also important factors.

Laboratory tests have been developed to measure the increase in fuel quality needed to prevent "knocking" as deposits are accumulated in the combustion chamber. The difference between the octane number of the fuel to prevent knock when the engine is clean and when the engine has run 120 hours is hereafter referred to as octane requirement increase or ORI.

Oils containing very heavy, or high boiling range stocks contribute much to the formation of deposits in the combustion chamber, and, therefore, high ORI. Different methods of refining for the heavy stocks did not improve their behavior in the combustion chamber. Substitution of low viscosity, low boiling range neutral stocks, along with V.I. improvers, reduces the ORI by 40 percent. In general, the lower the boiling range of the stocks employed, the lower the ORI, but the use of such stocks in lubricating oils is limited by increased consumption. Another way of improving ORI is by the selection of proper additives to compound oils for this particular problem. An over-all reduction from an ORI of 25 to an ORI of 5 was possible through the use of proper stocks and additives.

Road tests in different types of cars showed a reduction of about four octane numbers in the quality of fuel needed to operate free from "knock" when using the improved oil as compared to the usual type of oil being sold today.

Preignition in modern engines may be defined as the ignition of the fuel air mixture by some hot spot, such as corn flake type deposits, rather than by the spark plug. Laboratory tests show that the oil containing low boiling range

Limited Supply
Reprints of Petroleum Refiner's
1952 PROCESS HANDBOOK
Refining Processes
In a Nutshell

A limited supply of reprints of Petroleum Refiner's 1952 Process Handbook is available. This issue contains 78 process descriptions, 78 flow diagrams and Marshall Sittig's 54-page monograph, "Catalytic Cracking Techniques in Review." This handbook offers refining men their only complete source of such process information. **$1 per copy.**

Mail This Coupon Now . . .

GULF PUBLISHING COMPANY: Enclosed is $_____ for _____ copies of reprints of Petroleum Refiner's 1952 Process Handbook. Send to:

Name _____

Address _____

City _____

PETROLEUM REFINER
Reprint Department
P. O. Box 2608 • HOUSTON 1, TEXAS

"SERV-RITE"

Insulated Thermocouple Wire Extension Lead Wire

FOR

PLATINUM COUPLES
CHROMEL ALUMEL
IRON CONSTANTAN
COPPER CONSTANTAN
IRON CUPRONEL

No matter what your wire or insulation requirements may be, you can depend on Gordon "Serv-Rite" insulated wire for pyrometers—recognized as a standard of highest quality for nearly half a century. All "Serv-Rite" wire is now manufactured in the new, completely modern Gordon plant, employing up-to-date equipment and machinery, supervised and operated by skilled technicians—your guarantee of continued precision quality. In addition to maintaining large stocks of all common types of wire, Gordon will manufacture special insulation, in long or short runs, to suit your individual needs and meet your most rigid specifications.

All Types of Insulation

Felted Asbestos
Asbestos Braid
Weatherproof Braid
Glass Braid
Polyvinyl Plastic
Nylon Braid
Stainless Steel Armored Braid
Silicone Treated
Cotton Braid
Lead Jacket

The home of "SERV-RITE"

Full Particulars on Request

4229

GORDON SERVICE

CLAUD S. GORDON CO.

Manufacturers & Distributors

Thermocouple Supplies • Industrial Furnaces & Ovens
Pyrometers & Controls • Metallurgical Testing Machines

Dept. 25 • 3000 South Wallace St., Chicago 16, Ill.
Dept. 25 • 2035 Hamilton Ave., Cleveland 14, Ohio

Who's Meeting . . .

stocks and selected additives lower the octane number of the fuel required for preignition free operation by more than ten numbers. Road tests in cars showed an improvement of five to eight numbers.

This specially formulated oil, when tested in the laboratory knock test, did not have the ability to remove deposits that had been laid down in the combustion chamber when the engine was operated with an oil containing heavy stocks such as bright stock.

Fundamental Question

Joel Warren, Ethyl Corporation, discussed the results of an investigation which was directed toward determining why deposits increase antiknock requirement. Data were presented which indicate that substantially 100 percent of the increase in octane-number requirement caused by deposits results from a combination of thermal and volume effects. An analysis procedure was presented which indicates that deposit-thermal effects may result entirely from the heat that is stored in the deposits. Thus, the deposits absorb heat during the combustion process in one cycle and transfer it to the fresh charge during the intake and compression portions of the following cycle. Based upon the findings reported in this paper, those engines with the smallest area of combustion-chamber surface, for a given displacement, would be expected to have the smallest thermal effects, and hence should have minimum deposit effects.

NGAA

The fourth annual West Texas regional meeting of the Natural Gasoline Association of America has been scheduled for Friday, February 26, 1954, in the Lincoln Hotel, Odessa.

Discussions of gas measurement, petrochemicals, engine and compressor maintenance and corrosion will fill the technical portion of the program, while two addresses by leading oil executives on broader phases of the industry will be features of the afternoon session.

Members of the program committee for the meeting are: W. D. Noel, president, Odessa Natural Gasoline Company, chairman; J. M. Sappington, Barnhart Hydrocarbon Corporation; W. T. Edwards, Frontier Natural Gasoline Company; K. L. Haught, Fullerton Oil Company; Ernest Iles, Gulf Oil Corporation; R. R. Davison, Lion Oil Company; John R. Leonard, Magnolia Petroleum Company; W. L. Phillips, Phillips Petroleum Company; E. D. Dickey, Shell Oil Company; S. M. Sisley, Shell Oil Company; J. R. Green, Skelly Oil Company; E. R. Wagner, Stanolind Oil & Gas Company; Charles W. Ward, Stanolind; Harry P. McClintock, Tex-Harvey Oil Company; L. I. Baker, The Texas Company, and John E. Springer, Tide Water Associated Oil Company.

AI

At their annual meeting the board of directors of the Asphalt Institute

NATIONAL AIROIL

Oil Burners

OF THE STEAM AND MECHANICAL TYPES NOW COMBINED INTO

Dual Stage BURNERS

Now, at last, the inherent advantages of *both* systems of fuel oil atomization are *profitably* yours . . . within the one, new NATIONAL AIROIL Dual Stage Burner.

41 years of combustion equipment design and manufacture are in back of the Dual Stage Oil Burner . . . and, it has been thoroughly tested and proved in the field for firing: Petroleum Processing Heaters; Rotary Kilns; H.R.T., Scotch Marine and Water Tube Boilers; etc.

Available in three sizes, the NATIONAL AIROIL Dual Stage Burner fires all grades of fuel oil from No. 2 to No. 6, with a ready capacity of 80 to 300 g.p.h. Further, for a perfect flame pattern, we would recommend using with the Dual Stage Burner either the NATIONAL AIROIL Universal Register for forced draft or the NATIONAL AIROIL Tandem Unit for natural or induced draft furnaces.

Get detailed description, illustration, and specifications in NATIONAL AIROIL Bulletin 25.

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
STEAM ATOMIZING OIL BURNERS
SLUDGE BURNERS, Steam Atomizing
MOTOR-DRIVEN ROTARY BURNERS
MECHANICAL PRESSURE ATOMIZING OIL BURNERS
DUAL STAGE, combining Steam and Mechanical Atomization
LOW AIR PRESSURE OIL BURNERS
AUTOMATIC OIL BURNERS, for small process furnaces and heating plants
GAS BURNERS
COMBINATION GAS & OIL BURNERS
FUEL OIL PUMPING and HEATING UNITS
FURNACE RELIEF DOORS
AIR INTAKE DOORS
OBSERVATION PORTS
SPECIAL REFRACTORY SHAPES

NATIONAL AIROIL BURNER COMPANY, INC.

1254 East Sedgley Ave., Philadelphia 34, Pa.
Southwestern Division: 2513 So. Blvd., Houston 6, Tex.

Fractions SOLVE BIG PROBLEMS

The petroleum industry has made good use of the "divide-and-rule" formula that conquered kingdoms . . . to win command of the giant powers hidden in nature's oil. The industry's process engineers have transformed American life by their mastery of petroleum's secrets . . . and fractionating has been their master key.

These engineers' ability to develop processes which break petroleum into its component fractions has harnessed the "black gold" into a myriad forms of service. There have been other important results, too. The gigantic motor industry . . . America's vast network of modern highways . . . the services to motor travel—these are largely by-products of the petroleum process engineer's knowledge of fractional distillation.

For many years, Sun Ship has been adding to its own prestige by the service and cooperation its great shops give to the petroleum industry, and to the many other industries which call on Sun Ship's versatile engineering and construction skills. It has built . . . for chemical and petroleum process engineers, and for refineries throughout the world . . . the immense fractionating towers, pressure vessels, special machinery and heavy equipment they require. The 95'7" crude tower shown in the photograph, ready for shipment, is a representative example.

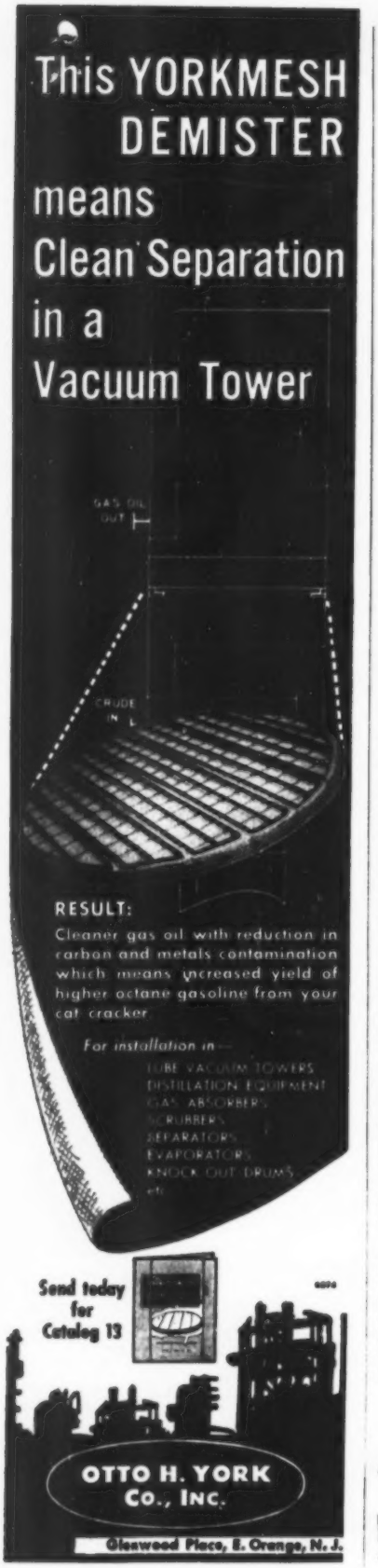
Sun Ship's services will continue to keep pace with the giant strides made by the nation's industries in the engineering progress which is steadily building a greater America.

Sun

SHIPBUILDING & DRY DOCK COMPANY

ON THE DELAWARE (SINCE 1916) CHESTER, PA.

25 BROADWAY • NEW YORK CITY


This YORKMESH DEMISTER means Clean Separation in a Vacuum Tower
GAS OIL OUT
CRUDE IN
RESULT:
Cleaner gas oil with reduction in carbon and metals contamination which means increased yield of higher octane gasoline from your cat cracker
For installation in—
TUBE VACUUM TOWERS
DISTILLATION EQUIPMENT
GAS ABSORBERS
SCRUBBERS
SEPARATORS
EVAPORATORS
KNOCK OUT DRUMS
etc.
Send today for Catalog 13
OTTO H. YORK Co., INC.
Gleanwood Place, E. Orange, N. J.

Who's Meeting . . .

elected Raymond Harsch, manager of the Asphalt department of Shell Oil Company, San Francisco, chairman of the Executive Committee for the coming year and reelected Bernard E. Gray president.

Vice presidents elected for the five U. S. geographical divisions of the Institute were: George R. Christie, Socony-Vacuum Oil Company, Inc., for Atlantic Coast Division; Lysle Walker, Leonard Refineries, Inc., for Ohio-Great Lakes Division; Chester Eberle, Macmillan Petroleum Corporation (Arkansas), for Mid-West Division; James J. Kelly, Kerr-McGee Oil Industries, Inc., for Southwest Division; W. F. Lyte, Douglas Oil Company of California, for Pacific Coast Division. These vice presidents, together with Harsch and Gray; and D. N. Myers, Byerlyte Corporation, ex-officio as retiring chairman, constitute the Executive Committee for the coming year.

Herbert Spencer was reelected secretary of the Institute. George R. Christie, Socony-Vacuum Oil Company, Inc., was reelected treasurer and John N. Smith, also of Socony-Vacuum, assistant treasurer.

WPRA

The first in a series of five regional meetings sponsored by WPRA in 1954 was held in Beaumont, Texas, February 11-12. The association's 42nd annual meeting will be held at the Plaza Hotel in San Antonio, Texas, March 29-31. The dates and locations for additional regional meetings are: May 27-28, Broadview Hotel, Wichita, Kan.; June 24-25, Leonard Refineries, Inc., auditorium, Alma, Mich.; September 23-24, Henning Hotel, Casper, Wyo.; October 21-22, Garrett Hotel, El Dorado, Ark.

Speakers heard during the Industrial Relations Session included Homer T. Fort, Jr., public relations director, Magnolia Petroleum Company; Karl H. Mueller, attorney, and F. Roe Weise, associate director, Industrial relations department, Standard Oil Company (Indiana). Fort's topic was "Filling the Holes in Employe Communications." Mueller and Weise spoke on the Taft-Hartley Law and the effect that possible future revisions of the act would have on the oil industry. An industrial relations panel discussion was held, with L. B. Gough, industrial relations manager, Magnolia Petroleum Company, as chairman of the session.

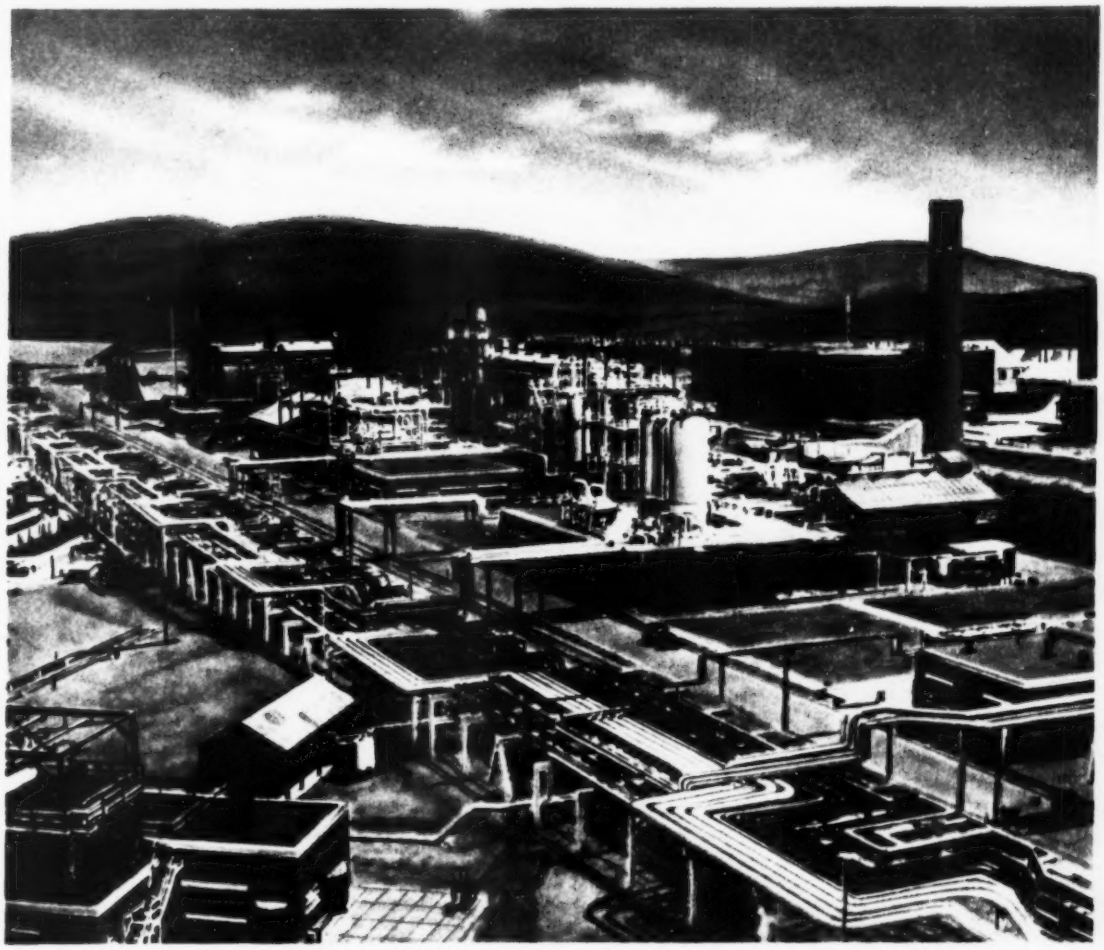
Four papers in the technical session were based on requests by refiners in the Gulf Coast area. Topics included: "Oxygen Susceptibility of Distillates," by J. W. Davis, U. S. Bureau of Mines, "Acetylene Profits from Refinery Coke," by E. L. Jones, Blaw-Knox Company, "Feedstocks for Catalytic Cracking Units," and "Viscosity Index Improvers."

Award to T. M. Lumly

The Richards Memorial Award was presented to T. M. Lumly, president of Refinery Engineering Company, at the ASME banquet held in New York.

IN THE FUTURE

FEB.	
11-12	Western Petroleum Refiners Association (Regional Meeting), Hotel Beaumont, Beaumont, Texas.
15-17	American Petroleum Institute (Lubrication Committee), Sheraton-Cadillac Hotel, Detroit.
23-24	Packaging Institute (Petroleum Packaging Committee), Houston.
26	Natural Gasoline Association of America (Permian Basin Regional Meeting), Lincoln Hotel, Odessa, Texas.
MAR.	
1- 5	American Society for Testing Materials (Spring Meeting), Shoreham Hotel, Washington, D.C.
2- 4	Society of Automotive Engineers (National Passenger Car, Body and Materials Meeting), Statler Hotel, Detroit.
8-10	American Institute of Chemical Engineers, Statler Hotel, Washington, D.C.
8-10	Oil Industry Information Committee, Shamrock Hotel, Houston.
15-19	National Association of Corrosion Engineers (Tenth Annual Conference), Municipal Auditorium, Kansas City, Mo.
24 to Apr. 1	American Chemical Society, Kansas City, Mo.
25	National Industrial Conference Board, Ambassador Hotel, Los Angeles.
29-31	Western Petroleum Refiners Association (Annual Meeting), Plaza Hotel, San Antonio, Texas.
APRIL	
5- 7	American Society of Lubrication Engineers, Netherland-Plaza Hotel, Cincinnati.
12-15	Society of Automotive Engineers (National Aeronautic Meeting), Statler Hotel, New York.
14-16	National Petroleum Association (51st Semi-Annual Meeting), Cleveland Hotel, Cleveland.
21-23	Natural Gasoline Association of America (13rd Annual Convention), Baker Hotel, Dallas.
MAY	
3- 5	American Petroleum Institute (Lubrication Committee), Skytop Lodge, Skytop, Pa.
3- 5	Air Pollution Control Association (Annual Meeting), Patten Hotel, Chattanooga, Tenn.
3- 7	American Petroleum Institute (Safety & Fire Protection Committees, Midyear Meeting), Chase-Park Plaza, St. Louis.
9-12	Liquefied Petroleum Gas Association (Annual Convention), Conrad Hilton Hotel, Chicago.
10-13	American Petroleum Institute (Division of Refining, Midyear Meeting), Rice Hotel, Houston.
16-19	American Institute of Chemical Engineers, Springfield, Mass.
17-21	National Fire Protection Association, (58th Annual Meeting), Statler Hotel, Washington, D.C.
20-21	National Industrial Conference Board (38th Annual Meeting), Waldorf-Astoria, New York.
27-28	Western Petroleum Refiners Association (Regional Meeting), Broadview Hotel, Wichita, Kansas.
JUNE	
6-11	Society of Automotive Engineers (Summer Meeting), Ambassador and Ritz-Carlton Hotels, Atlantic City, N.J.
9-11	Oil Industry Information Committee, Edgewater Beach Hotel, Chicago.
13-18	American Society for Testing Materials (Annual Meeting and Exhibits), Sherman Hotel, Chicago.
21-25 (tentative)	American Institute of Electrical Engineers (Combined Summer and Pacific Meeting), San Francisco.
24-15	Western Petroleum Refiners Association (Regional Meeting), Leonard Refineries, Inc., Auditorium, Alma, Michigan.
27 to July 1	Petroleum Equipment Suppliers Association, Manoir Richelieu, Murray Bay, Quebec, Canada.



ON A HILLSIDE IN SOUTH WALES

Llandarcy, the Anglo-Iranian Oil Company refinery situated on a hillside near Neath, South Wales, has grown since 1946 from 360,000 tons to 4,000,000 tons capacity per year.

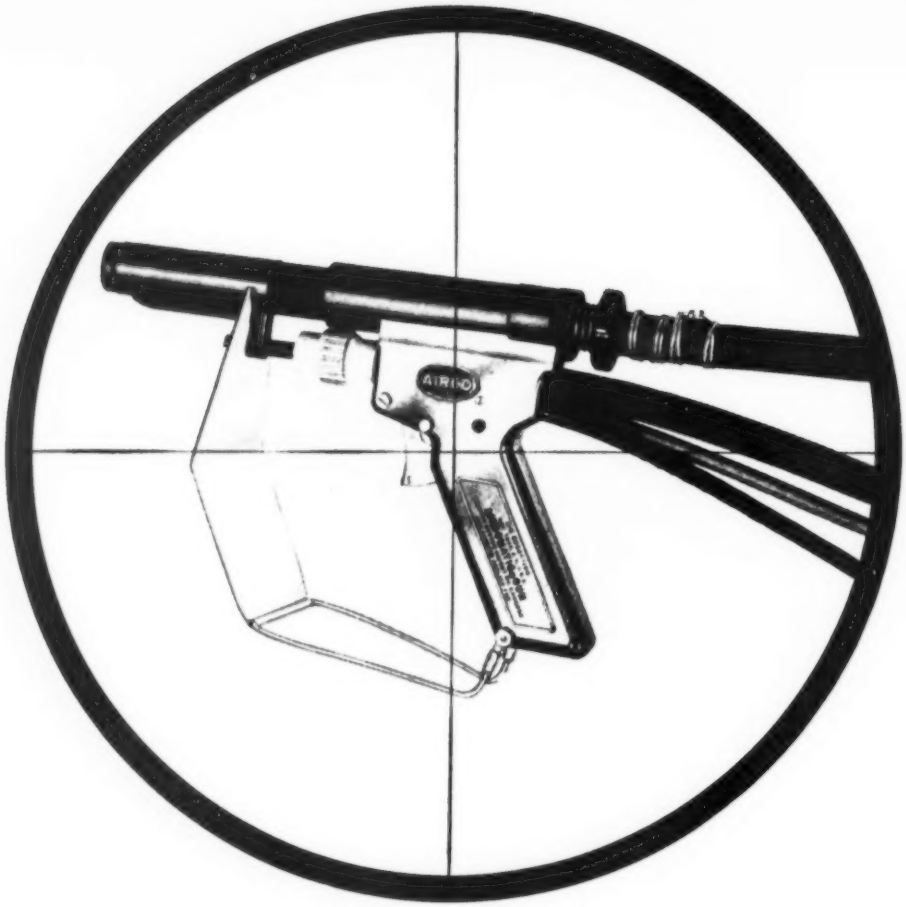
In this development program Badger Process Division of Stone & Webster Engineering Corporation, and its affiliate, E. B. Badger & Sons Limited, have played a major part.

Some of the new and modern facilities already completed or under construction are crude distillation, catalytic reforming, propane deasphalting, furfural extraction, solvent dewaxing, wax manufacturing and clay treating.

STONE & WEBSTER ENGINEERING CORPORATION

BADGER PROCESS DIVISION

AFFILIATED WITH E. B. BADGER & SONS LIMITED



gun for lower welding costs!

Fast production of high quality welds in aluminum, bronze, copper, nickel, stainless steel and the other "hard-to-weld" materials . . . that's the money-saving secret of the Aircomatic® process!

Lower costs through speed . . . With Aircomatic, these advantages add up to a tidy time-saving on every joint: high deposition rate . . . lower weld metal requirements because of the improved joint designs made possible . . . *and* a sizeable reduction in the cleaning time provided by Aircomatic's "no-slag" characteristic.

Lower costs through quality . . . Welds made with Aircomatic are unmatched for strength, fusion, appearance and freedom from cracking and porosity . . . because Aircomatic controls penetration and dilution . . . because high current densities and concentrated heat reduce distortion to a minimum.

This inert-gas-shielded metal arc process can be used with manual guns like the 500-amp. Model 20 shown above, or automatic equipment. Upkeep and wire costs are low. Write today for the Aircomatic Catalog, and list of recently lowered wire prices.

AIRCO®

AIR REDUCTION MAGNOLIA COMPANY

A Division of Air Reduction Company, Incorporated

P.O. Box 319, Houston 1, Texas

Beaumont • Corpus Christi • Dallas • El Paso • Fort Worth • Hobbs
Oklahoma City • San Antonio • Shreveport • Tulsa • Wichita Falls

at the frontiers of progress you'll find

AN AIR REDUCTION PRODUCT

Southwestern Headquarters for Oxygen, Acetylene and Other Gases . . . Carbide . . . Gas Welding and Cutting Machines, Apparatus and Supplies . . . Arc Welders, Electrodes and Accessories

Reviewing New Books . . .

Free Enterprise at Work

The Texaco Story—The First Fifty Years, Marquis James, The Texas Company.

Three years after the Spindletop gusher of January 10, 1902, production of the miracle field near Beaumont, Texas, dropped from 62,000 barrels to 5000 barrels a day, within one year. With the drop, most of the 200 oil companies engendered by the strike faded from view as quickly as the historic well itself dropped in production. Of the original 200 companies, only two have survived to become factors in the oil industry today.

In "The Texaco Story—The First Fifty Years," Marquis James, Pulitzer prize-winning biographer, chronicles the early struggles and later success of one of the survivors, The Texas Company. The book, sponsored by The Texas Company, has just come off the press.

Texaco survived at a time when dropping production devastated other companies because of the farsightedness of Joseph S. Cullinan. "Buckskin Joe," as he was called in his young days, arrived in the midst of the Spindletop boom a few days after the first well blew in. A successful oil man and honor graduate of the most astute oil business school in the world at that time—the Rockefeller, or Standard school—he saw the opportunities that lay in getting the Spindletop oil to refineries. To this end he enlisted the aid and financial assistance of eminent personalities in the business circles of the day to found Texas Fuel Company.

Arnold Schlaet, a New York investor who came to respect Cullinan as a practical oil man, was one of the prominent men to join the venture, but he made clear at the time that he disagreed with one detail in Cullinan's plan. As Texas Fuel Company was not chartered to produce oil, Cullinan wanted to organize an affiliated producing company. Schlaet considered the idea premature, contended there was too much production already. (At one time at Spindletop water sold for 10 cents a cup while oil went for only 3 cents a barrel.)

Without Schlaet's help or sanction (Schlaet had returned East), Cullinan had his way about a producing company. With another group of wealthy men he organized Producers Oil Company as an affiliate of Texas Fuel Company, which on April 7, 1902, became The Texas Company.

When Spindletop began playing out, Texaco faltered, but only for a short time. Through the newly formed Producers Oil Company it took big and profitable parts in strikes at Sour Lake, Saratoga and Batson, Texas, and Jennings, Louisiana.

From this beginning, James' story of Texaco's growth evolves into a strong argument for competitive private enterprise. With Cullinan in Texas, organizing, planning and continuously expanding it, and Schlaet in New York, pushing sales and securing much of the capital needed for Cullinan's seemingly reckless schemes, the company grew. It declared its first dividend the first year, and began construction of an asphalt plant and a refinery. Its next ten years saw a growth even more phenomenal. Four refineries were built to go with the original one; its Port Arthur-to-Humble pipe line was extended all the way to Tulsa, and its sales organization was pushed over most of the U. S. and into foreign countries. These and other developments enabled Texaco to move forward against the competition of other independents and against Standard.

Cullinan left the company he had played such a large part in founding in 1913 and, in so doing, provided an appropriate marker at the end of Texaco's formative years.

From that time to this, except for the depression years, The Texas Company history has been marked by steady technical and scientific advances and by spectacular expansion. World War I, the increased use of automobiles, foreign

ASTM Specifications

ASTM Standard on Petroleum Products and Lubricants, American Society for Testing Materials, 1916 Race Street, Philadelphia 3. $6.

The 1953 edition of this compilation includes, in their latest form, most of the ASTM specifications, test methods and definitions widely used in this field. (The tests for knock rating of engine fuels and certain standards for measuring and sampling are issued in special manuals and not included in this compilation.)

Prepared by ASTM Committee D-2 on Petroleum Products and Lubricants, this edition provides 146 ASTM standards, including 130 test methods; 10 specifications; 1 classification of diesel fuel oils; 3 definitions of terms relating to petroleum, specific gravity, and rheological properties of matter; 2 recommended practices: one for the purchase of uninhibited mineral oil for use in transformers and in oil circuit breakers, and one for designating significant places in specified limiting values; and other material.

Tower Packings

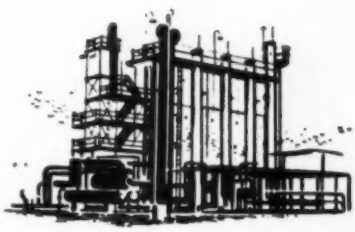
Tower Packings and Packed Tower Design, Max Leva, The United States Stoneware Company, 60 East 42nd Street, New York. $8.50.

This second edition, almost double the size of its predecessor published two years ago, incorporates an extensive increase of general data throughout all sections of the book. So great is the increase, in fact, that the book takes on the characteristics of a new reference manual on its subject, tower packings and packed tower design.

Such topics as pressure-drop, flooding, hold-up and distillation are covered in detail. A discussion on tower auxiliaries is also presented, as is a recent work of British researchers which augments the sections on data generalization and liquid-liquid contacting.

PROBLEM

To produce hydrogen essentially free of carbon monoxide which has a deleterious effect on product quality and plant capacity for edible oil producers.



SOLUTION

GIRDLER developed a highly active durable catalyst, G-12, for removal of carbon monoxide from the hydrogen. Cost of hydrogen production was reduced and carbon monoxide content was cut 95% resulting in:

Hydrogen with less than 5ppm of carbon monoxide

Take advantage of the experience of Girdler in solving *your* catalyst problems!

FOR

Catalysts

WRITE...

The

GIRDLER

Company

A DIVISION OF
NATIONAL CYLINDER GAS COMPANY
Gas Processes Division
LOUISVILLE 1, KENTUCKY
NEW YORK • TULSA • SAN FRANCISCO

New Books . . .

trade, development of the Holmes-Manley thermal cracking process, advertising, World War II, and many other events gave impetus to Texaco's growth. Today it is the fourth largest oil company in the U. S.

"The Texaco Story" is the story of men endowed with the competitive spirit. Marquis James has written it in a clear and concise style which might well be adopted by all serious company publications. Full of facts, figures, dates and names, the story, nevertheless, has continuity from the beginning—but not to the end, for the end of "The Texaco Story" has yet to be written.

Cooling Tower Lumber

Cooling Tower Wood Maintenance, CTI Bulletin TSC-302, Cooling Tower Institute, 444 Emerson St., Palo Alto, Calif. $.20.

Discussions and conclusions presented in this report on the subject of deterioration of cooling tower lumber are based primarily on, and limited to, a direct examination of 103 operating cooling towers. Located in the Gulf Coast area extending from Brownsville, Texas, to Baton Rouge, La., the towers included all commercially available types and designs with wide age range and confined in size to what may be considered industrial towers. Considerations drawn from general knowledge on the subject supplement the discusssions.

Improve Your Process!

STAUFFER CATALYSTS

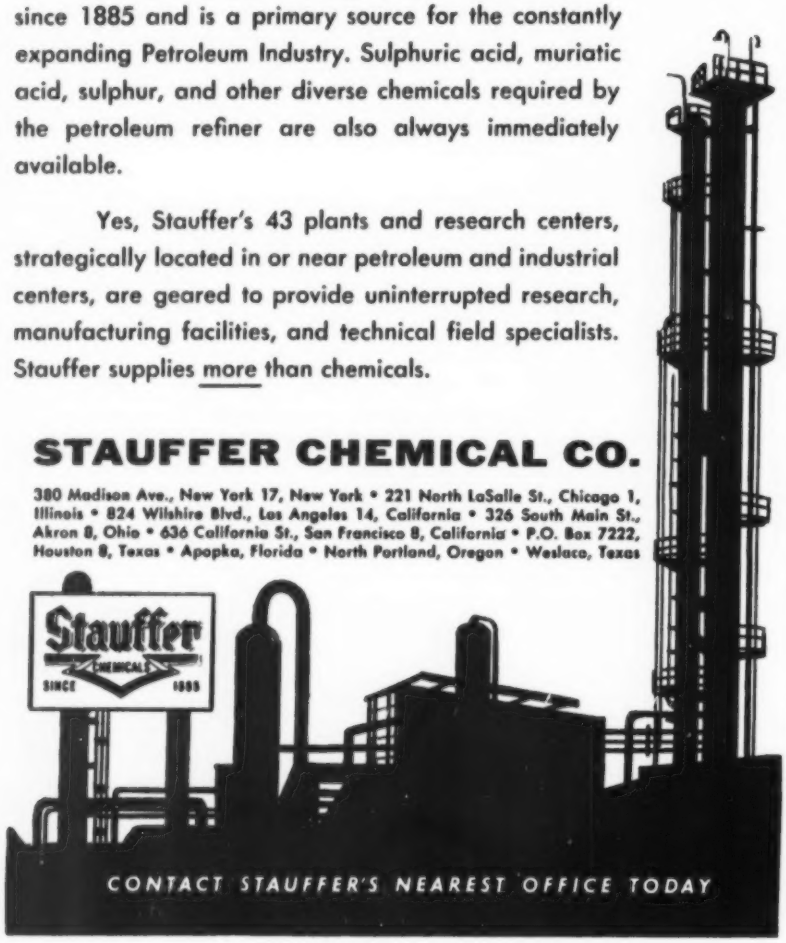
Give Higher Yields and Better Quality!

Stauffer has been supplying heavy chemicals since 1885 and is a primary source for the constantly expanding Petroleum Industry. Sulphuric acid, muriatic acid, sulphur, and other diverse chemicals required by the petroleum refiner are also always immediately available.

Yes, Stauffer's 43 plants and research centers, strategically located in or near petroleum and industrial centers, are geared to provide uninterrupted research, manufacturing facilities, and technical field specialists. Stauffer supplies more than chemicals.

STAUFFER CHEMICAL CO.

380 Madison Ave., New York 17, New York • 221 North LaSalle St., Chicago 1, Illinois • 824 Wilshire Blvd., Los Angeles 14, California • 326 South Main St., Akron 8, Ohio • 636 California St., San Francisco 8, California • P.O. Box 7222, Houston 8, Texas • Apopka, Florida • North Portland, Oregon • Weslaco, Texas



CONTACT STAUFFER'S NEAREST OFFICE TODAY

Oil Gasification

IGT Research Bulletin 16, Fluid Gasification of Oil, J. M. Reid, W. J. Merwin, C. G. von Fredersdorff, H. R. Linden and E. S. Pettyjohn, Institute of Gas Technology, Technology Center, Chicago 16. $5.

This IGT bulletin presents the results of a study of the application of fluid cracking techniques to high Btu oil gas production.

Fluidization studies were carried out in small-scale laboratory units. The most promising materials were tested for these desirable characteristics as heat-transfer media: 1) high thermal conductivity, 2) high specific heat, 3) high density, 4) high softening point, and 5) resistance to attrition. Of several available materials meeting these requirements, dehydrated silica gel was chosen for the pilot plant tests.

Fluid gasification studies were made with a two-barrel per day pilot unit in which both distillate and residual oils were gasified. It was found that in a fluid bed reactor using a given heat-transfer medium the process variables which affect the results of gasifying oils are similar to those controlling gasification results in other types of equipment.

Measurement Tables

ASTM-IP Petroleum Measurement Tables, Metric Edition, Institute of Petroleum, 26 Portland Place, W.I., London. £2 15s. 0d. (about $7.70).

With publication of this Metric Edition of the ASTM-IP Petroleum Measurement Tables, the planned trilogy—British, U.S.A. and Metric—has been completed. The British Edition was published in December, 1952.

In addition to a number of tables which are common to all volumes, this edition contains three tables which are particularly applicable to the metric system of measurement. They are: Reduction of Observed Density at 15 C. (254 pages); Reduction of Volume to 15 C. against Density at 15 C. (111 pages); and an abridged version (13 pages) of the latter.

Prior to the appearance of this volume no authoritative petroleum measurement tables covering metric units were in existence. Because of beliefs held by both the ASTM and the IP, the tables are constructed upon the same basic data for the coefficients of expansion, etc., as had been used in compiling the British and American Tables. This will result in computation of bulk quantities of petroleum being equivalent in the three major systems.

Instrumentation

Instrumentation for the Process Industries, The Instruments Publishing Company, Inc., 845 Ridge Avenue, Pittsburgh 12, Pa. $2.

Complete proceeding of the Eighth Annual Symposium on Instrumentation for the Process Industries have been combined in this 36-page booklet. The symposium, conducted by the School of Engineering, Agricultural and Mechanical College of Texas, College Station, Texas, January 28-30, 1953, included these papers: "How Automatic Can We Get?," "The Secrets in An Instrument Engineer's Notebook," "Use of Field Test Data for Control System Analysis," and "Men and Meters."

for the Petroleum Industry

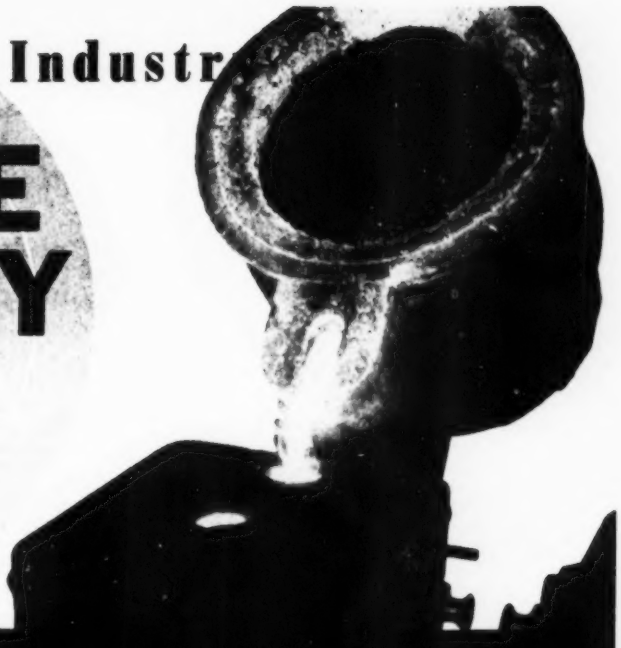
SERVICE FOUNDRY

top quality metallurgical control—

expert workmanship throughout, from

office force to delivery, has made

our name what it is today!



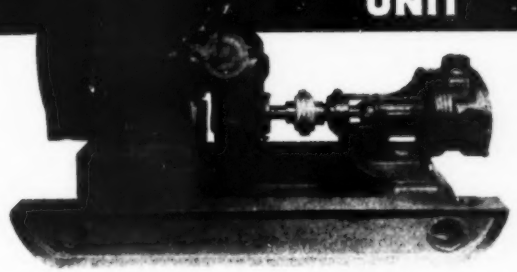
SERVICE FOUNDRY a division of AVONDALE MARINE WAYS, Inc.

416 Erato Street, New Orleans, U. S. A. P. O. Box 1030, New Orleans, U. S. A.

Cable Address: "Serfdry"

Another Efficient

VIKING PUMPING UNIT



Viking pumps are giving top performance wherever used in the petro-chemical industry. The above installation is serving a major pipeline company and consists of: a Viking Model L-124, Size 2" Standard fitted heavy duty rotary pump mounted on welded steel skids and direct connected through 7 F Falk coupling to a 2 cylinder Air Cooled Power Unit.

Write for new literature or engineering counsel.

Distributors

SOUTHERN ENGINE & PUMP COMPANY

MANUFACTURERS • MACHINERY FACTORS • CONTRACTORS

Houston – Dallas – Kilgore – San Antonio – Edinburg – Corpus Christi, Texas. New Orleans, Louisiana.

WIRE MESH

Jelliff

Specializing in the non-ferrous metals in counts to 200 x 200 or 50 x 750 and widths up to 18" in all commercial weaves

IN MESH WITH INDUSTRY

Since 1880

address your enquiries to Department 16

The C. O. JELLIFF MFG. CORP.

SOUTHPORT • CONNECTICUT • USA

WIRE PRODUCTS Jelliff SINCE - 1880

Don't Drug Employe Incentive!

Labor peace at any price results too often in systematic destruction of work incentive, one of the great supports of American freedom.

F. M. Butler, Director of Industrial Relations,
Cities Service Oil Company,
Bartlesville, Okla.

"The human donkey requires either a carrot in front or a stick behind to goad it into activity. The whole drift of British society for two generations past has been to whittle away both at the carrot and at the stick until now very little of either is left . . . And yet we wonder why the donkey doesn't break into a trot."—London Economist.

Work incentive, a support of American freedom, is being corroded by employe benefits through which companies are paying additional, well-hidden wages.

WORK INCENTIVE, the greatest support beam of the American freedom, is being systematically destroyed by management's wistful regard for labor peace af any price.

Natural incentive is being corroded by methods intended to keep the peace, to quiet difficulty. These usually have come in the course of collective bargaining when serious labor difficulty threatened.

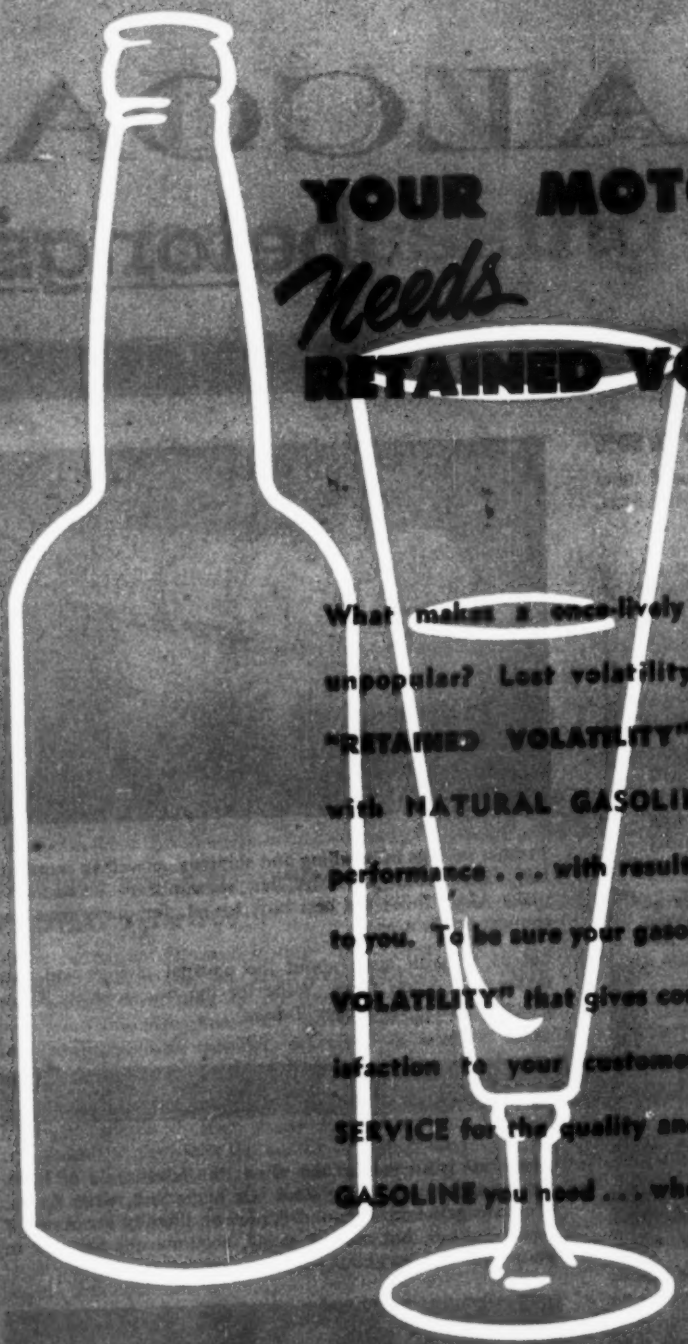
Few connected with labor matters were fully conscious of what they were doing when the straight seniority clause was written into American industry. It is fair and right to give job preference to senior employes with ability and required qualifications. However, the method of applying many seniority provisions convinces employes that they need exert only enough effort to hang onto their jobs. They will eventually advance within their unit when the man next older in service retires, dies, gets fired for gross negligence, or gets tired of suppression of his initiative and quits for other work. The young employe who puts in a little extra effort is considered in many places as an "eager beaver," and shortly, through lack of incentive, he is not using his initiative or giving his best efforts to his work. These, naturally, are being given off somewhere else as he seeks recognition outside his job.

A guarantee against the brother-in-law type of advancements and layoffs, itself an equally bad practice, is the reason claimed by unions for their insistence on straight seniority. But instead of being cured of the measles, the worker got the whooping cough.

It is shameful to admit that some of us have agreed to provisions in bargaining which were directly aimed at curtailing employe effort—such as severely defining and restricting work which crafts can do so that highly paid craftsmen must remain idle while another craftsman or laborer performs some small incidential non-skilled part of the job at hand. This is "feather-bedding," an out-and-out drug to incentive.

Who Will Get Job First?

Most companies have become so ac-



YOUR MOTOR FUEL *Needs* RETAINED VOLATILITY *too!*

What makes a once-lively drink stale, flat and unpopular? Lost volatility. Motor fuel without "RETAINED VOLATILITY" gained by blending with NATURAL GASOLINE soon goes flat in performance . . . with results definitely unprofitable to you. To be sure your gasoline has the "RETAINED VOLATILITY" that gives consistent and uniform satisfaction to your customers, rely on WARREN'S SERVICE for the quality and quantity of NATURAL GASOLINE you need . . . where and when you want it.

WARREN

PETROLEUM CORPORATION

TULSA, OKLAHOMA • Cable Addresses: STAVOLENE, WARREN

EXPORT TERMINALS: CORPUS CHRISTI, PORT ARTHUR, BAYTOWN TEXAS CITY AND WARRENGAS, HOUSTON, TEXAS

YOUR POCKETBOOK WILL TELL YOU

ALCOA belongs

ALUMINUM HEAT EXCHANGER TUBES SAVE UP TO 80%

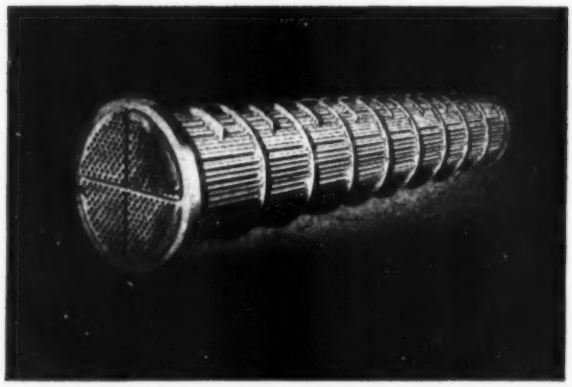
Alcoa Aluminum Tubes cost far less than other metal tubes . . . 1/2 the price of Admiralty, 2/3 the price of Mild Steel, 1/5 the cost of Stainless!

An average-sized refinery can save $50,000 in first cost by using Alcoa Aluminum Tubes (figured on 20,000 tubes) as this chart shows:

PRICE PER 16 FOOT LONG TUBE

	⅝" O.D.x .049" wall	¾" O.D.x .049" wall	¾" O.D.x .065" wall	1" O.D.x 065" wall
3S-H14	$1.31	$1.50	$1.82	$2.37
Alclad (inside) 3S-H14	1.66	1.92	2.28	3.02
Seamless Mild Steel	2.68	2.82	3.18	3.49
Admiralty Brass	3.31	3.94	5.00	6.68
Cupro Nickel (30%)	4.87	5.71	7.46	10.03
Stainless Steel (304)	8.61	9.67	11.38	13.73

NOTE: *All prices are approximate. Prices for 3S-H14 and Alclad 3S-H14 based on lots of 2000-4999 lbs., for Admiralty and Cupro Nickel 5000 to 9999 lbs. Prices for Mild Steel and Stainless based on lots of 10,000 ft. with exception of size 1" O.D. x .065" wall which is based on 5000 ft.*



Further savings in handling and shipping, as well as excellent low temperature properties and resistance to corrosion—make Alcoa tubes the best buy, by far, for many heat exchanger applications.

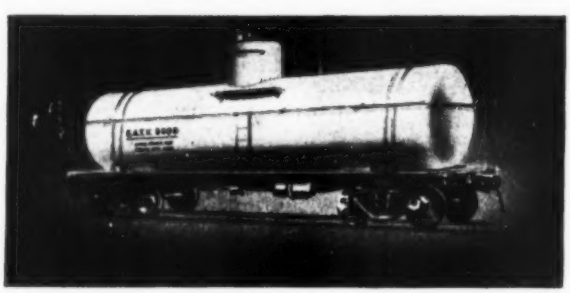
Let us tell you more about the unusual savings you can make with Alcoa tubes. Write for the *free* booklet, *Alcoa Aluminum Heat Exchanger Tubes.*

ALUMINUM TANK CARS SAVE UP TO 33⅓%

Tank cars made of Alcoa Aluminum cost one-third *less* than stainless steel tank cars—savings well worth your investigation!

Aluminum does not contaminate or discolor sensitive liquids—does not promote decomposition. Result: *no damage to ladings, better end products.* Aluminum is highly resistant to most corrosive ladings—requires far less maintenance than other metals.

Alcoa pioneered the aluminum tank car more than 25 years ago . . . and that original car is still hauling fatty acids. *There's* proof that aluminum resists corrosion, gives lasting service, doesn't contaminate its cargo. If you want further proof, ask your car builder about the advantages of lightweight aluminum rolling stock. Or better still, write Alcoa. We have gathered facts and figures on literally hundreds of liquid ladings that can be safely, economically shipped in aluminum. Ask us about *your* commodity today.



ALUMINUM
in processing

ALUMINUM COILED TUBE SAVES UP TO 40%

ALCOA UTILITUBE* is aluminum coiled tube made of a specially selected alloy to provide low cost, easy workability and high fatigue strength.

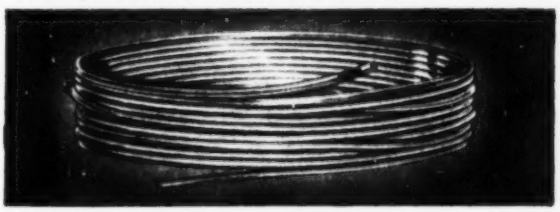
Alcoa Utilitube offers savings up to 40 per cent over copper . . . has excellent on-the-job forming and flaring properties. It is available in economical, long lengths up to 1,000 feet or more, depending on size. It stands up well under vibration . . . has high resistance to most industrial atmospheres and to many liquids and gases.

*Registered Trademark, Aluminum Company of America

Use Alcoa Utilitube for:

- PNEUMATIC CONTROL CIRCUITS.
- GASOLINE AND FUEL OIL FOR INTERNAL COMBUSTION ENGINES.
- LUBRICATING OILS FOR ENGINES AND MACHINES.
- FLUIDS FOR HYDRAULIC SYSTEMS.

For complete details, write for the booklet, *Alcoa Utilitube.*

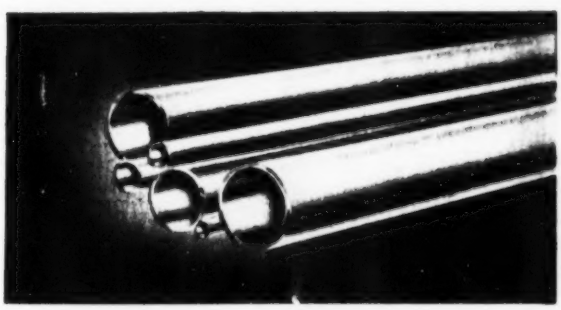


ALUMINUM PIPE IS THE LOWEST COST CORROSION-RESISTANT METAL PIPE.

Alcoa Aluminum Pipe and Fittings offer tremendous advantages to the chemical, petroleum and food processing fields. It is equally applicable for oil, gas, water, compressed air and mine drainage pipe lines. Structural uses, too, have become increasingly popular, especially in outdoor areas subject to corrosive fumes or salt spray.

Aluminum pipe, of course, is highly resistant to attack by hydrogen sulfide in sour crude and most other sulphur compounds . . . protects the quality of high-grade resins and other naval stores. It can be joined by every fusion process . . . is easier to handle and install because it only weighs 1/3 as much as other metal pipe. Its chemical inertness and corrosion resistance avoid batch and process contamination. High thermal conductivity and ductility speed filling of vessels with cold liquids.

You get all these cost-cutting qualities when you use Alcoa Pipe in the processing field. Write for the booklet, *Alcoa Aluminum Pipe and Fittings.*



For process chemicals, catalysts, catalyst carriers and desiccants, investigate Alcoa Chemicals.

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

ALUMINUM COMPANY OF AMERICA
905-B Alcoa Building, Pittsburgh 19, Pa.

I would like more information on:

☐ Alcoa Heat Exchanger Tubes ☐ Alcoa Utilitube
☐ Alcoa Aluminum for Tank Cars ☐ Alcoa Aluminum Pipe
☐ Alcoa Chemicals

NAME _____
TITLE _____
COMPANY _____
ADDRESS _____

customed to using sedatives in employe relations that we actually seem to be competing to see who can grab the needle and jab it in first. It is only since we have recently seen what opiates have done to the English worker that we have begun to get really concerned about the American worker who is being drugged into the worst condition possible—that of expecting to receive without giving. This is entirely unnatural; nothing in nature ever received without giving.

Most of us should have had that principle better in mind when we began the race of placing in effect such so-called employe benefits as retirement plans, group life, group hospitalization, and other social programs through which the company pays the employe additional and well-hidden wages. There is nothing wrong with these plans if the employe knows that he is paying for them himself. But few companies indoctrinate their employes with the fact that such benefits are really an added wage. Rather, it seems to be the general attitude of some companies to let the rank-and-file believe that these benefits, in large part, are being given them by a paternalistic, generous organization.

As a result, many employes have no particular knowledge of origin. Their benefits are just things which happen, things they receive, and for which no effort is necessary, no giving in return. Those who doubt this are invited to poll their own employes to see how many know the amount of wage money the employer is paying into their retirement plan or group insurance or group anything else that doesn't actually appear on the pay check stub.

They Administer the Hypo

This type of hidden wage payment is especially encouraged by a government which does not tax employes for wages received through benefits. So the hypo is being administered by (1) Uncle Sam, through tax laws by which government and politicians try to claim credit for those wages which the company is paying in the employes' behalf; (2) the unions, which try to obtain unsound employe security provisions; and (3) the companies, through opportunism or lack of understanding of the results of their policies.

Two of the worst employe opiates are social security and unemployment insurance, devised for workers by a paternalistic government. They are a part of wage costs, paid out in earmarked taxes to government, but they are not considered as part of wages by employes. They are things which happened so far back that the American worker has forgotten that he is paying the bills.

Security vs. Job Opportunity

One result of this is that company pension plans and other forms of built-in security have become more interesting to some young people than job opportunity. It is not unusual for personnel people to have the tables reversed when they are interviewing prospects on college campuses. The prospect interviews the personnel man to learn which company will assume the greatest number of his life responsibilities for the shortest period before retirement at the highest rate. The question is not, "How can I develop initiative and give?" but "How can I become secure and take?"

It is way past time for the oil industry to start re-establishing incentives, to appeal to man's true nature, which is life-giving, not life-taking, and to fill the hypo needle with a shot

BFC*
SEAMLESS
ROLL FORGED
STEEL RINGS
OFFER
PRECISION-
QUALITY-ECONOMY!
-up to 50% less stock allowed for finish machining...
RINGS forged on our RING-ROLLER require 50% less stock than those completed by hammering. Finish is similar to rolled bar stock. Tolerances are closer and stock is evenly distributed. Rings are true, round, of uniform thicknesses, permitting rapid chucking and machining.
RESULT: A 50% saving in machine costs.
Practically immediate deliveries!
BEAUMONT FORGING Company
POST OFFICE DRAWER 836 BEAUMONT, TEXAS TELEPHONE 4-9486

YOU GET MORE!

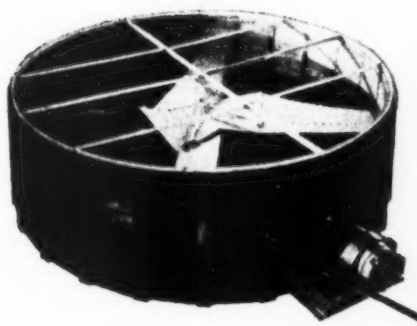
There are many reasons why you get more from Pritchard Heavy-Duty Cooling Towers. One of these is the exclusive patented features incorporated into Pritchard advanced cooling tower design.

Features like the POWAIRSAVER* fan—the first fan exclusively designed, built, rated and tested on an induced draft cooling tower for cooling tower service. These lightweight fans are designed for longer life with corrosion-resistant stressed skin blade surfaces, made of monel metal or stainless steel depending upon your specific service requirements. These patented fans are designed to operate with high aero-dynamic efficiency at low horsepower—your key to top cooling tower performance.

Over the years, leaders in the petro-chemical industry have learned *all* the reasons why Pritchard cooling towers give them more. If *you* want more efficiency . . . more years of dependable performance . . . from your next cooling tower, be sure to consult Pritchard—a founder member of the Cooling Tower Institute.

*Registered Trade Name

Industry's Partner for Progress



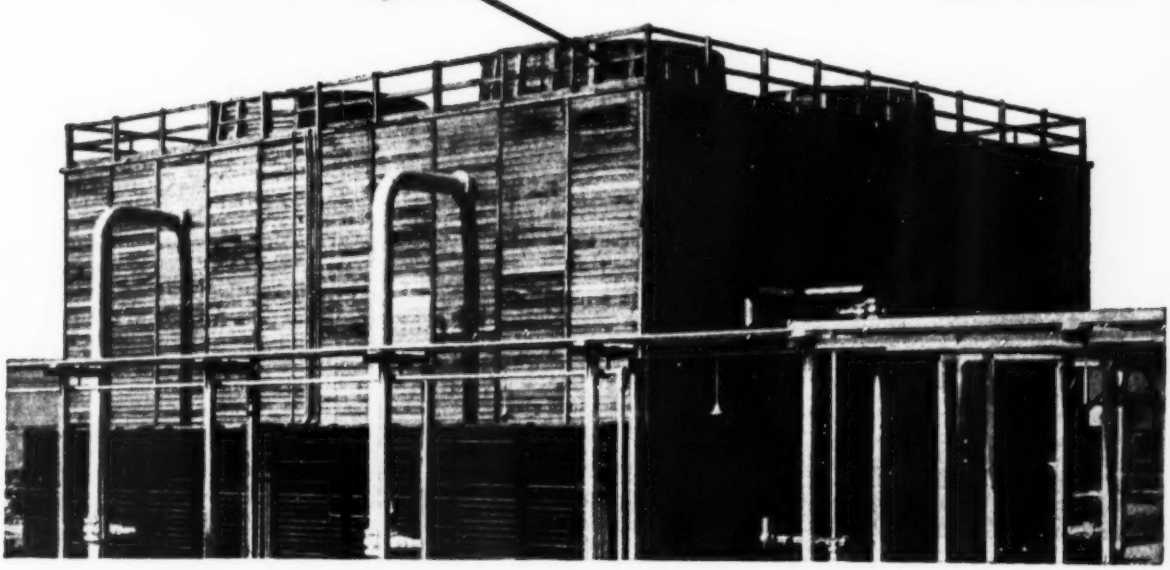
J.F. Pritchard & Co.

ENGINEERS • CONSTRUCTORS • MANUFACTURERS
Dept. 328, 210 West 10th Street, Kansas City 5, Mo.

Chicago • Houston • New Orleans
New York • Pittsburgh • St. Louis • Tulsa

Representatives in Principal Cities from Coast to Coast

COOLING TOWERS • SPECIALIZED HEAT EXCHANGERS • GAS & AIR TREATING EQUIPMENT • CONSTRUCTION & PROCESSING FACILITIES



of adrenaline instead of morphine.

How to Restore Incentive

Here are some of the methods that would restore incentive:

• On the first payday following any change in base wage or benefit wage, the employes should be informed by check inserts of the additional amounts they are receiving, directly or indirectly.

• Whenever practicable, the writer would have employes themselves pay for increases in pension and group insurance benefits. If the company finds that its total compensation to employes, including payments for all benefits plus wage, is not enough, then it should pay the employe more in cash wage and let him place the additional amount in the benefit plan. Let it be stressed that this is proposed only when practicable. It is not practicable to disregard a general practice in the industry or disregard a substantial tax advantage to the employes. In any event, the increase in benefit money should be granted on the basis of total compensation not being high enough; and when turned over to the employe, it should be made to appear what it actually is, which is additional wages.

• Employes should be encouraged to take part in the Thrift Plan, which definitely is not classified as an opiate type of benefit. The well-constructed thrift plan provides an opportunity for employe stock ownership, and thus contains a high element of incentive.

• Promotions should be made from the rank-and-file, union or non-union. Such a policy satisfies human nature's need for recognition and builds a healthy, loyal organization full of job incentive. Many rank-and-file employes have come to think they have no chance against the college graduate who receives most of the promotions. But all of us know that a college degree does not necessarily convey qualities of leadership.

Many employe union leaders possess qualities which warrant their promotion to supervisory work. In a number of cases the union has done a better job than the company in discovering and developing leadership. Recognition is the back-bone of incentive. It is well to bestow that needed recognition through salary increases, job promotions, publicity, and personal commendation.

• The next idea is part of the writer's individual program as a citizen. I intend to enlist the assistance of senators and congressmen effecting essential changes within our tax laws. The whole tax program works against incentive.

• The most lasting, the most certain way of getting employes to give freely of their initiative is by having first-rate first line supervisors. A company may have the best policies in the world, but without qualified foremen they are of no force. The first line supervisory group can make or break an employe relations program. For this reason a continuous program in human relations is necessary. We should maintain a running inventory of individual supervisors, their strong points and their short-comings, so that they can be developed in one instance and corrected in the other. If a supervisor is found to be lacking in the ability to draw out an employe's best efforts, he should be put to other work. At any rate, he should be removed from his supervisory capacity. The chips are too big to permit anything else.

This article is from a paper, "Employe Relations—by Opiates or Incentives," presented before the Western Petroleum Refiners Association at Casper, September 24-25.

A Shell Photograph

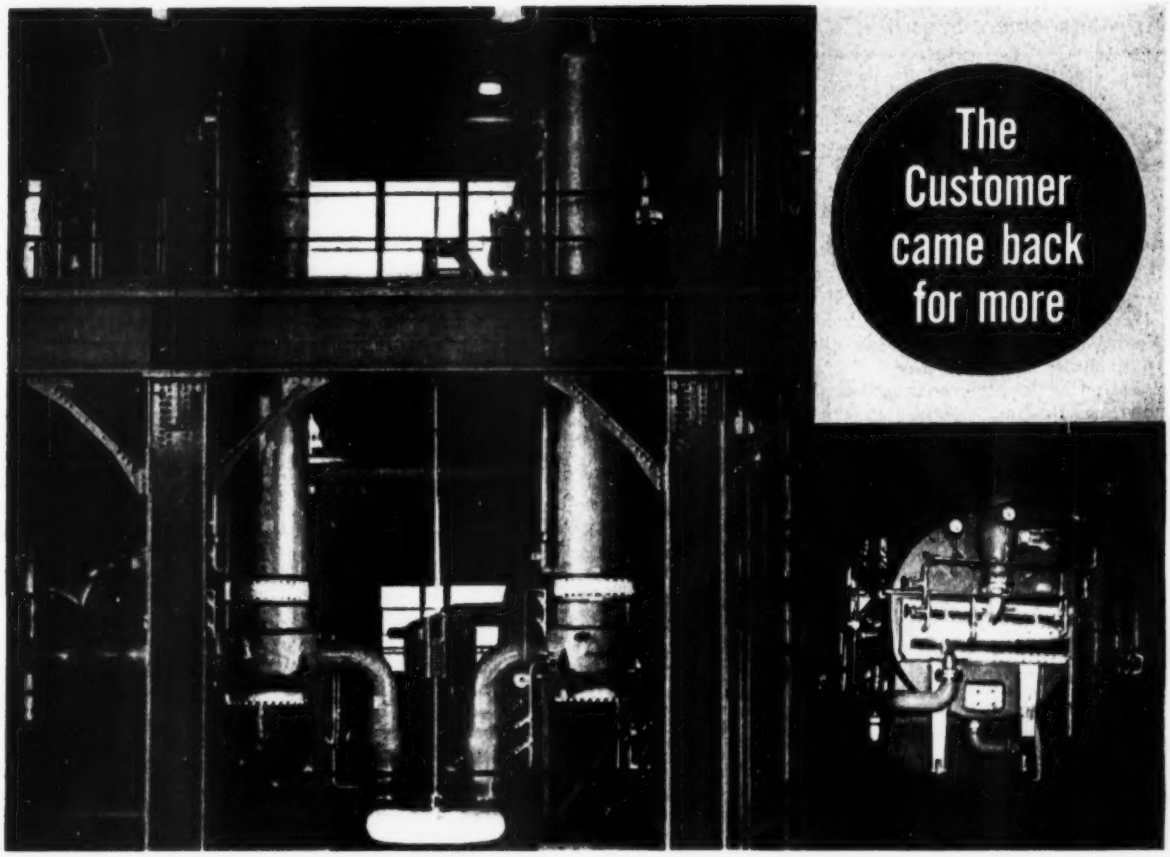
Kenyon provide a *complete* thermal insulation service to the oil industry, including technical advice on thermal insulation specifications, and finishes for all conditions. Supply of materials, application, supervision, on sites throughout the world. The photograph shows columns on the Distillation Unit. M.E.C. project at Ellesmere Port, Cheshire.

Call in KENYON to keep the heat in!

WM. KENYON & SONS (AMERICA) LTD., PERTH AMBOY, N.J., U.S.A.

WILLIAM KENYON & SONS LTD., DUKINFIELD, CHESHIRE, ENGLAND

KH 132



The Customer came back for more

The Arkansas Power & Light Company demands the economical design, careful workmanship and trouble-free performance such as Lummus heat transfer installations provide. In a succession of purchases, 5 evaporators, 6 high-pressure heaters, 7 low-pressure heaters, and 4 surface condensers (27,500 to 52,500 sq. ft.) have been supplied to power stations engineered for Arkansas Power & Light by Ebasco Services, Inc.

Shown here are high-pressure heaters and evaporator at the recently completed Lake Catherine Station of Arkansas Power & Light Company. On this job, Lummus furnished two Multilok high-pressure heaters, with a design pressure of 2,500 lbs. per sq. in. each, 2,710 sq. ft. for the No. 1 unit, and 2,521 sq. ft. for the No. 2 unit; two low-pressure heaters, one of 2,385 sq. ft. surface and the other of 1,950 sq. ft. surface. All heaters are of U-tube construction. Lummus also supplied an evaporator designed to produce a total vapor output of 25,000 lbs. per hour, with a guaranteed solids content of not more than 1.7 parts per million, when the shell liquid is maintained at 1,700 parts per million. This unit is designed with a Lummus cell type mechanical vapor separator.

Having seen how Lummus equipment performed in initial installations, this customer came back for more. The reaction of The Arkansas Power & Light Company is typical. We would be pleased to have our engineers discuss your problems with you.

THE LUMMUS COMPANY, Heat Exchanger Division: 385 Madison Avenue, New York 17, N.Y. • Atlanta • Boston • Chicago Rock Island • Cincinnati • Detroit • Houston • Tucson • Tulsa Salt Lake City • Minneapolis • Pittsburgh • Rochester Albany • St. Louis • San Francisco • Wayne (Phila.) • Athens Buenos Aires • Honolulu • London • Manila • Toronto Paris • Rome • Lima • San Juan, P. R. • Mexico City

Steam Surface Condensers • Evaporators • Extraction Bleeder Heaters • Steam Jet Air Ejectors • Steam Jet Refrigeration Barometric Condensers • Heat Exchangers for Process and Industrial Use • Process Condensers • Pipe Line Coolers.

Write For Your Free Copy of Our New 16 Page Evaporator Bulletin M 305.

LUMMUS

THE LUMMUS COMPANY HEAT EXCHANGER DIVISION, 385 MADISON AVE., NEW YORK 17, N. Y.

Sizing Up a Job Candidate

Auren Uris, Research Institute of America, New York

EXECUTIVE A, after 15 minutes of talk, has a clear picture both of the personality and abilities of the job applicant he is interviewing.

Executive B, after an hour of talk, feels he's getting nowhere. He later confides to a colleague, "It was like pulling teeth trying to get sensible answers out of the man."

And the man's reaction? "He (executive B) gave me a rough time. I know I made a terrible impression, but his tactics didn't help matters any."

How Do You Measure Up?

The hiring interview is one of the most challenging situations an executive faces. Frequently, it's a measure of the interviewer as well as the interviewee.

Most executives instinctively follow most of the rules of sound interviewing. The trouble is, omission of a single one of them may lead to an unsatisfactory result. Here are the highlights of a successful interviewing method. How well do your own practices match up?

1. Are you aware of the interviewer-interviewee relationship?

It's important to understand the attitude of the man across the desk. In the average case, the job interview represents a major test. A great deal of hope and expectation may hang in the balance. You should expect him to be tense, for example. Also to be expected is the probability that he'll react differently in the interview than he would ordinarily, unless certain positive steps are taken.

And don't mistake your own role. Clearly, you're in the driver's seat. All the more need, for you, therefore, to treat the applicant with consideration. The initiative, of course, rests with you. What happens, or doesn't happen during the interview—results from what you do.

2. Do you know how to put him at ease?

"Smile, be friendly, put the interviewee at ease." These are generally accepted principles for opening an interview. They aim to relax the person you are talking to. Trouble is, they are not easily achieved.

The difficulty is that in most instances the job applicant's tenseness is likely to be deep-seated. To really do the job right, therefore, you may have to work at relaxing him during the entire interview. It can be done if you think in terms of a two-level interview:

. . . **Defrosting.** This part of the activity—your manner, what you say, what you do—aims at putting him at ease.

You have a better chance of success by—

(a) **making it low pressure.** In the defrosting period, stay away from critical or touchy matters.

(b) **asking routine questions.** It may even be desirable to spend a few minutes on unrelated or trivial matters. Pose only those questions which can be answered without hesitation, involving no strain or possibility of upset.

You can usually tell when your defrosting is successful. In one man's case, you'll know he's relaxed because he draws lightly on his cigarette. In another case, you can tell by his expression—the quality of his smile, for example. When signs of tension disappear, you are ready for—

. . . **Brass tacks.** Now you can go ahead and ask questions that directly concern your objectives.

Just keep in mind that tensions sometimes recur. You may put the applicant at ease, and then possibly because a question has hit a sensitive area, he's no longer relaxed. In this case, switch back to the defrosting level momentarily.

3. What kind of pattern should your interview follow?

The nature of the information you get is influenced by your choice between (a) a directed interview or (b) a flexible interview:

The directed interview. You keep a pretty tight grip on the reins, guide your talk along the lines you've set in advance.

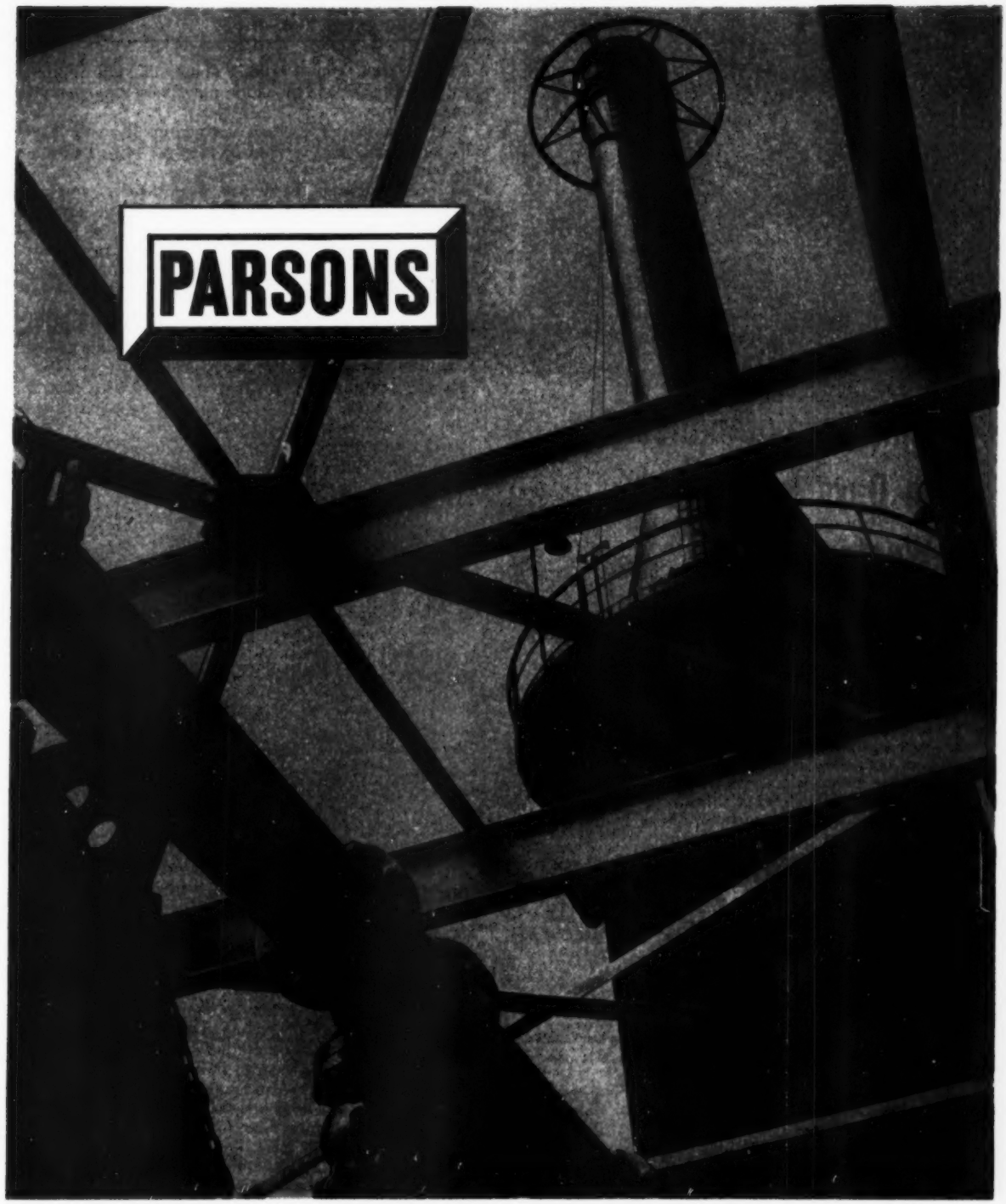
The flexible interview. Sometimes called the nondirective interview, this method is more or less self-generating. The question you ask at any given time stems from the answer or reaction to a previous question. The line of your questioning must be flexible to permit you to follow up all the possible angles.

Here's a comparison of the two methods:

Directed Interview	Flexible Interview
Application	
Best for investigations with well-defined goals and clear-cut lines of questioning. Examples: jobs with simple qualifications—secretarial, for instance.	Especially suitable for measuring an applicant for a difficult job, in which personality, for example, may be a critical factor.
Preparation	
Can be mapped out in advance, and in complete detail.	You can only decide on your general objectives, have to tailor the interview as you talk.
Time Limit	
The length of the interview is almost entirely in your hands.	You can't be too sure how long you'll have to stay with it to do a thorough job.
Results	
Likely to give you what you're after for routine purposes: personnel record data, work experience, etc.	Best method for giving an applicant a chance to open up. It's an ideal digging tool.

4. Do you make the best possible contact?

Occasionally, an interviewer finds himself up against a problem even tougher than silence—that's over-politeness.

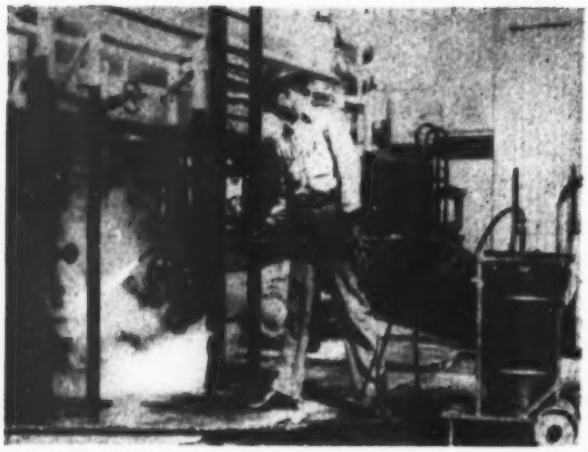


THE RALPH M. PARSONS COMPANY

ENGINEERS · CONSTRUCTORS

617 SOUTH OLIVE STREET, LOS ANGELES 14, CALIFORNIA

NEW YORK • TULSA • WASHINGTON, D.C. • ANKARA



Cleaning Maintenance Cut from Days to Hours at Western Refinery

Refinery finds Oakite Detergent applied with Oakite Steam Gun makes short work of cleaning prior to repainting.

THE cleaning problem this California refinery had was simple enough. It was one of removing all dirt, grease and muck from tanks, pumps and similar equipment. But actually doing the job was not so simple. It meant tedious scraping, wirebrushing, wiping by a sizable crew. It involved struggling with hard-to-get-at surfaces. Did the Oakite Man have a better answer?

He did—as a result of his wide refinery cleaning experience. For this particular case, he suggested the Oakite 384 Steam Gun. He helped Maintenance get started that morning. By afternoon, the plant superintendent stated, "One man did about two weeks' work today".

Proving that—
in industrial cleaning it always pays to consult Oakite.

YOUR OAKITE TECHNICAL SERVICE REPRESENTATIVE.—His experience is yours to draw on. He knows "cleaning engineering" and the conditions under which refinery cleaning can be best performed. His responsibility only *begins* when you order materials. He keeps in touch with you. He sees to it that the job is done right the first time, at lowest cost. Call him in . . . no obligation.

SEND FOR BOOKLET F7629

Full of helpful information on jobs such as:

Drum reconditioning • Descaling
Salvage cleaning • Tank interiors
Paint stripping

Write to OAKITE PRODUCTS, INC.,
44C Rector St., New York 6, N.Y.

SPECIALIZED INDUSTRIAL CLEANING

OAKITE

MATERIALS • METHODS • SERVICE

Technical Service Representatives in Principal Cities of U. S. & Canada

No matter what you're talking about, the job applicant agrees, and answers in the mildest and most non-committal terms.

Politeness, in this case, is a coverup. Beneath it you often find fear, nervousness, the resolve "not to stick my neck out."

To break through the armor of politeness, you must first make sure that you yourself have not set the example. Informality, frankness and friendliness on your part are the only real cures. You convey your interest in the interviewee as a person by the things you say. During the course of the interview you have an opportunity to show—

Agreement. Where you can do honestly, go along with the views that the interviewee expresses. "I often feel that way myself." Your willingness to share his feelings and attitudes makes for a better contact.

Encouragement. A hesitant or shy interviewee can often be given increased self-confidence by such phrases as: "I see"; "That's very clear"; "Go on."

Understanding. Finding that he's face-to-face with someone that really understands him can break down many obstacles to good contact. Try: "I get what you mean"; "Your reasons are understandable."

5. Should you use tricks?

Some executives report favorably on an interviewing stunt which they say, gets them information they could not otherwise get. One man, for example, speaks highly of his success in uses the "Stress" technique. To see how an applicant will react, for example, he may start an argument, noting whether the applicant will fight back, cave in, etc. etc.

Interviewing devices of this kind may or may not be desirable, depending (a) how you use them; (b) what you are after. Keep in mind, for example, that the interview situation may be totally unlike any job situation in which the applicant later finds himself. Many a high powered, aggressive executive, for example, may be able to think back to *his own* hiring interview in which he was as nervous as the average.

An important point to keep in mind, of course, is that you may have to work with the man you hire. Any unfavorable advantage you may have taken in the course of your interview may lower your rating in the mind of the interviewee.

6. Do you know the best way to end the interview?

Talk that just peters out is likely to leave the interviewee with a "so-what" feeling. The interview must have a definite windup. Cover these points as you close.

. . . Sum up: "We seem to have covered all the necessary points in our talk, Mr. Smith."

. . . If you have no unanswered questions, make sure the same is true of him. Give him a final chance to clear up any doubts he may have.

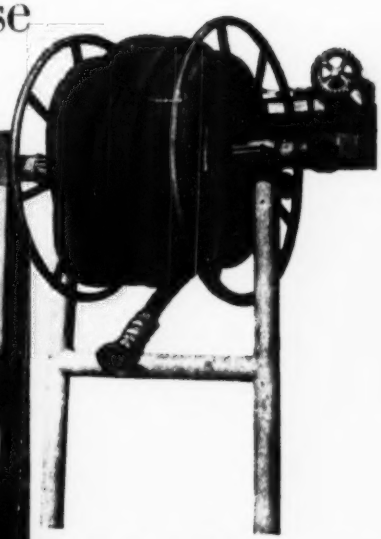
. . . Keep the way open for a return engagement. If there are still unexplored areas to be covered, or any issues which have been raised which require further attention, let him know these won't be neglected.

. . . Tell him you'll keep him informed of any new developments which effect him.

. . . Thank him for his cooperation.

Finally, keep in mind that in many companies and in many communities, the interviewing of job applicants is an activity affecting not only your hiring but also your relations with the public. Fairness, pleasantness and courtesy have never done any known harm, either to a company's or an executive's reputation.

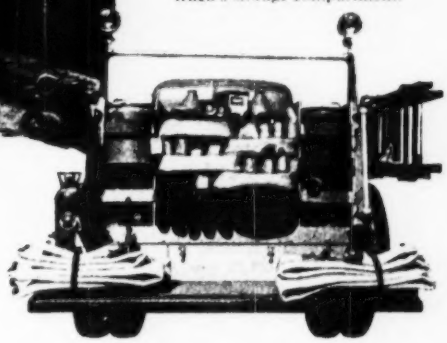
Maintenance men and firefighters rely on U. S. Rubber Hose



Above is a "U. S." neoprene-covered fire hose in a refinery. It is resistant to sun, chemicals, oil, abrasion and mildew. It has the popular fog nozzle.

(left) **"U. S." hose** used for fire fighting as well as general wash-down purposes.

(below) **U. S. Matchless Carbolized** fire hose can handle 500 gallons per minute. Note how its flexibility allows it to be folded into the truck's storage compartment.



Many a leading modern refinery depends on "U.S." hose of several types to help protect against fire. Each hose is specially designed and built to handle a definite set of working conditions. Highest grade materials, scientifically compounded rubber, uniformity of construction, skilled workmanship – these are the secret of "U.S." hose superiority. For extra special circumstances, "U.S." engineers will develop hose to meet your requirements. Write to address below.

PRODUCTS OF U.S. RUBBER

UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION • ROCKEFELLER CENTER, NEW YORK 20, N. Y.

TC
TENNESSEE CORPORATION

SULPHUR-DIOXIDE
HIGHEST QUALITY
SO_2

YOUR SAFEST ROAD
TO
BEST RESULTS!

Many progressive industries have already found the way to increased profits and satisfactory results by using Tennessee's highest quality Sulphur-Dioxide. Perhaps you, too, have a specific process in which this product can be used to advantage. In most cases, a more efficient and economical operation can be achieved through using this chemical (SO_2) with its variety of uses. We can supply Tennessee's highest quality Sulphur-Diovide in cylinders, ton drums, tank cars and tank trucks. Let our own technical experts show you how you might employ it to your greatest expedience and economy.

CONTAINERS

- Cylinders
- Ton Drums
- Tank Trucks
- Tank Cars

For detailed information, phone, wire or write—

TENNESSEE TC CORPORATION

617-29 Grant Building, Atlanta, Georgia

The Courts Say . . .

in recent insurance cases

Shelton

This column is to inform—not advise. It presents the current trend in legal thinking on insurance cases. The law varies from state to state and its application depends upon the facts of the particular case. Do not attempt to apply it without consulting your attorney.

Joseph M. Shelton, Attorney at Law, Dallas

That trip for a "Hot Breakfast" was in course of employment

EMPLOYE was a nightwatchman. On weekends he was required to be at employer's plant on continuous uninterrupted duty from Saturday noon until 7:30 a.m. Monday. He was allowed to go home Sunday morning for a hot breakfast and to pick up his lunch. It was understood he was on "company time" while on this trip home. On a Sunday morning, on his way home, he was killed by a train about 400 yards from the plant. The insurance company appealed from the jury's award of death benefits.

The U. S. Court of Appeals said in affirming the judgment that the danger encountered by employe was peculiar to the long period of uninterrupted employment and the necessity of the trip home for nourishment. The allowance of the trip home for a hot meal doubtless contributed to efficiency in his duties for the employer. The condition was an inducement to employe to take the job and an important part of the employment contract. He was in the course of his employment when injured.

—New York Casualty Co. v. Wetherell
193 F. 2d 881 (U.S.C.A., 5th Circuit, 1952)

That control exercised constituted employment

PLAINTIFF R—, who operated a truck, alleged he was an employe of a corporation owned by S— and his three sons. The corporation mixed cement and obtained their sand and gravel from a pit owned by S—, individually. The sand and gravel was hauled by truck drivers, who owned their own trucks, paid their own expenses, and were paid by the load by the corporation. S— instructed the drivers to "keep the trucks rolling," bring their lunch and not stop for refreshments. Compensation was awarded R— and the insurance carrier contending that R— was an independent contractor appealed.

The Texas Court said the jury could reasonably believe that R— was not employed for a "specific piece of work," but was actually employed for an indefinite period of time to work with his truck. That company officials decided when work was to begin and end; that they directed how the sand and gravel was to be loaded, washed and drained and that the trucks should be "kept rolling" all of which entitled the jury to conclude that it was employment rather than an independent contractor relationship.

—Maryland Casualty Co. v. Real
244 SW 2d 865 (Tex. Civ. App., San Antonio, 1951)

That injuries from fight over union dues were compensable

EMPLOYE rode to work with friends who parked in company lot. R— came to the car and began questioning the men. Employe left car and walked toward plant gate. R— attacked him from rear. It developed that R— was a union steward who evidently intended to restrain plaintiff from working if his dues were not paid. The jury awarded employe 149 weeks compensation for disability from injuries sustained in the fight. The insurance carrier appealed, contending employe was not in the course of his employment.

See THE COURTS SAY, Page 250

GUARD AGAINST DOWN TIME WHEN PRESSURES ARE UP

With Watson-Stillman Forged Steel Fittings . . .

The high cost of down time in today's high pressure processing and power plants demands careful selection of piping materials. This goes *double* for the fittings.

WATSON-STILLMAN FORGED STEEL FITTINGS give you maximum protection against high pressure, heat, corrosion, shock and vibration —elements often responsible for piping failures.

All W-S Carbon Steel Fittings are drop forged to produce the well-known forged-fiber structure with exceptionally high tensile and impact strength. They're designed for high strength, too, with extra heavy walls where you need them. And they're precision machined for perfect alignment.

Watson-Stillman Fittings are also available in forged stainless and alloy steels for exceptional service at high and low temperatures and for maximum resistance to corrosion.

For strong, tough, trouble-free joints—for safe, dependable operation of your piping system—specify W-S Forged Steel Fittings. Available in sizes ⅛" to 4" in both SCREW-END and SOCKET-WELDING types. Write for information today.

Sold Through Leading Distributors

WATSON-STILLMAN FITTINGS DIVISION

H. K. PORTER COMPANY, INC.

Roselle, New Jersey

two valuable handbooks now available . . .

Limited Supply

1952 PROCESS HANDBOOK

Refining Processes In a Nutshell

- 78 process descriptions
- 78 flow diagrams
- Marshall Sittig's 54-page monograph, "Catalytic Cracking Techniques in Review"

Available in handy reprint form

$1 per copy

PETROLEUM REFINER'S

1953 PETROCHEMICAL PROCESS HANDBOOK

A Complete Source of Petrochemical Processes

- 55 process descriptions
- 55 flow diagrams
- 7 summation articles

$1 per copy

Order Now. Write to:

Reprint Department

PETROLEUM REFINER

BOX 2608

HOUSTON 1, TEXAS

Better Health for Executives

Part II

Your Working Habits

Reeve

Dr. B. B. Reeve
Medical Director, Standard Oil Company (Indiana)

YOU HAVE attained executive position through your hard work and your ability, and your combination of talent for administration. As an executive, you are an exceptional person with exceptional values to your organization.

A part of your work is to administer your organization, to ask yourself day-in, day-out, "How can I best fulfill my responsibility to my company?"

The smooth working of your organization depends upon working methods you direct and control. It depends, also, upon your own work habits. One of the most important factors in successful administration is continuing to develop good working habits. Your health also depends on your work habits, perhaps as much as on your other daily habits of living.

Each day is made up of 24 hours. Even though you are the exceptional person—the executive—the 24 hours were not all made for working. Each day should be divided into work, recreation, and rest. The individual executive who can avoid carrying his work into the hours he needs for recreation and rest will better preserve his health for other important days to come.

Working under pressure seems to be the habit of many in executive positions. Perhaps you've been pressured into working under pressure. Perhaps you've been schooled in this tradition. Perhaps your own incentives have led you to drive yourself—and others—under pressure.

Working under pressure can be essential, at time, of course. When it carries habitually into needed recreation and rest periods, industrial medical experience is that it travels down every nerve line of administration to the tips of your corporate body. Habitual pressure from the top more often results in loss of efficiency—in lessened results—than in a net gain of work done. And you may not be aware of the situation until the harm is done, until the cause is brought into sharp focus by your company physician, your personnel department, or through union complaints.

I have observed how continuous overtime may seriously affect the work and health of an entire department. The evidence convinces me that it is advisable—and it is good management—to avoid habitual and unnecessary overtime. It can only have an adverse long-term effect on the health and efficiency of your fellow employes—and on your own health.

This is different: If you have—or someday develop—a tendency to be exhausted at the end of the day, you'll find that a complete 20- to 30-minute midday rest period is worth two or three hours in the evening. Just try it!

And, remind yourself that you cannot work at capacity as an executive all day, yet keep up a whirl of social activities late in the evening. You should plan for, and insist on getting, the amount of rest you need each night. Burning the candle at both ends is burning yourself out.

See EXECUTIVES' HEALTH, Page 250

Note: The author is dealing in generalities. He is in no way offering relief for, nor suggesting treatment for specific ailments.

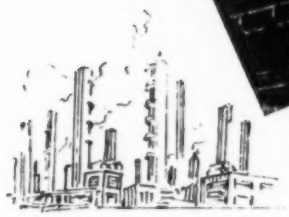
THIS 400,000 Pounds per HOUR

Vogt

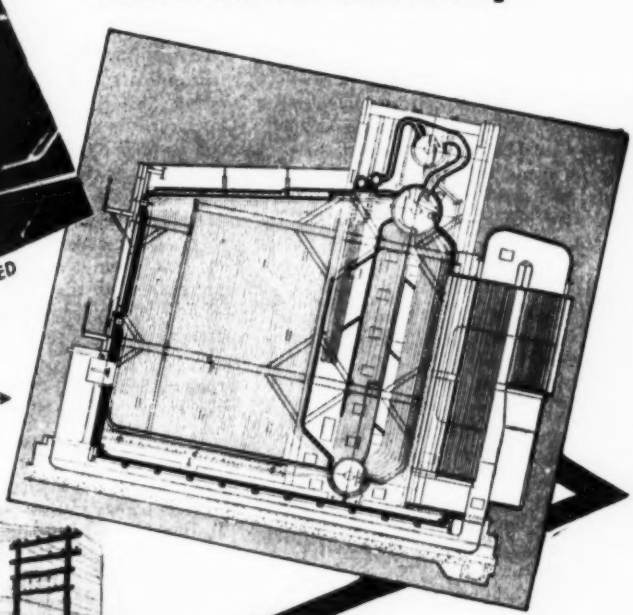
STEAM GENERATOR

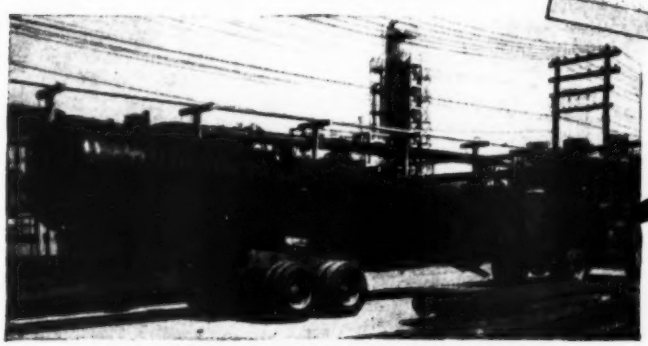
Gives Top Performance in a Leading Texas Petroleum Refinery

VIEW OF THE COMPLETED STEAM GENERATOR



RIGHT → LONGITUDINAL SECTION THROUGH THE UNIT.





6'-6" DIAMETER x 37'-0" LONG STEAM DRUM BEING TRANSPORTED TO THE ERECTION SITE DURING INSTALLATION.

PRINCIPAL DATA

400,000 pounds per hour capacity.

Fusion welded steam and water drums designed for 700 lbs. S.W.P.

Superheater delivers steam at 750°F. total temperature.

Water cooled furnace.

Burners for Oil and Acid Sludge fuel.

Vogt builds a complete line of bent tube steam generators designed to burn solid, liquid, or gaseous fuels to meet specific operating conditions. Write for bulletins.

HENRY VOGT MACHINE CO., LOUISVILLE 10, KY.

BRANCH OFFICES: New York, Philadelphia, Chicago, Cleveland, St. Louis, Dallas, Charleston, W. Va.

Shortage of Managerial Talent Critical

Part I

- **Retirement of top men often deferred**
- **Executive turnover increase alarming**
- **Interest high in executive training**

W. C. Eldridge, Booz, Allen & Hamilton, Los Angeles

EDITOR'S NOTE: *The problem of executive development of engineers has four distinct facets: (1) the critical shortage of managerial talent; (2) the increasing demand for engineering backgrounds at the management levels; (3) action being taken to prepare engineers for executive responsibilities; and (4) tailoring programs to the specific needs of engineers. This article deals with the first phase of the problem. The others will be discussed in subsequent issues.*

WHAT EVIDENCE is there of a critical shortage of managers?

First, there is the widespread holdover or deferred retirement of the top management group. We sensed the condition in 1949 and surveyed the managements of 65 companies to find out what had happened.

From the requirement standpoint, the survey established the fact that companies have been increasing their number of corporate officers. In 1929 there was an average of seven per company, while by 1949 the figure had increased to 11.

With respect to tenure, taking the senior officers alone (i.e., presidents, vice presidents, treasurers, controllers, and secretaries), they averaged 48 years of age in 1929 and 55 years in 1949—an increase of seven years. More significantly, the junior officers, who are normally regarded as replacements, averaged 52 in 1949—just three years younger than the men they should succeed.

Indefinite Postponement? No!

From these figures, it is apparent that replacements can't be postponed indefinitely. In fact, they will have to be at a more rapid rate in the next five to ten years than in the past. Where will these replacements come from? Many of them will have to come from other organizations.

It's the rather alarming increase in executive turnover that is the second piece of evidence of the general thinness that exists at management levels.

The results of our survey earlier this year indicated that industry has been adding executives at a 46 percent faster rate since the war and that it has been losing executives for reasons other than death and retirement at a pace one third faster than prewar.

Irrespective of the reasons for the individual moves, it is obvious that many of them would not have been precipitated if the executive doubted his ability to find a better berth elsewhere.

A third piece of evidence is the great current interest in executive development.

One of the obvious indications of management's preoccupation with the development of managerial talent is the recent story in *Business Week* titled, "Is It a Good Idea—or Just a Fad?" It points out that executive development was the top subject at last fall's conferences of the Society for the Advancement of Management. It noted that the American Management Association has launched a nationwide survey of what's offered in the way of executive development and is also sponsoring a critical study of the subject by Lyndall Urwick, management specialist.

The volume of current publications on the subject also indicates widespread attention. Last year the American Management Association published a 575-page handbook of Management Development Techniques and Case Studies called, "The Development of Executive Talent." API's manual on the development of men was published in April, 1952. The National Industrial Conference Board's report on company programs of executive development came out in 1950.

The bibliography of a survey of executive development practice made by our own Service Research department last year lists 48 books and articles. Of these, 39 were written since 1950—and the oldest only dates back to 1945. Bibliographies and other references paint the same picture—of high current interest in developing managerial talent.

Now look at some of the basic causes of the managerial shortage.

Basic Causes of Shortage

Since pre-World War II American businesses have been expanding rapidly both in numbers and size. The general statistics show a 12 percent increase in number of companies between 1939 and 1950. Size-wise, the census shows that American businesses trended to larger units. In 1939, 10 percent of the employed were in companies of 2500 employes and over. In 1947, 18 percent were in companies in that size bracket. At the other end of the scale, the percentage of employed in the 50 to 100 employe size group dropped from 11 to 9 percent.

In addition to larger numbers and greater size, there is the increased complexity of business operations.

It would take too much time to systematically tick off all things a business has to do today that it didn't do to any significant degree 20 years ago.

- There are things we do for the government—such as collection of income taxes and old age benefits.
- There are the things we do because of government—minimizing tax burdens, the contract accounting, depreciation and investment capital problems.
- There are the new or expanded functions—industrial relations, public relations, research and development, big legal departments, etc.
- There are all the complexities in-

YOU CAN'T ALWAYS STOP FIRE BUT YOU CAN

give your plant and equipment this added protection against the damages of fire!

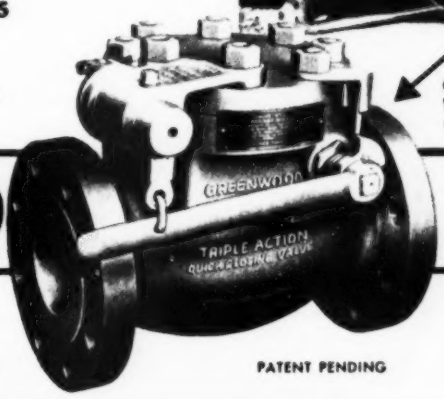
● Here's about the cheapest kind of fire insurance you can buy. Install GREENWOOD Triple-Action Quick-Closing Valves on all lines and tanks handling volatile or combustible products . . . and get effective protection against fire — day and night, year after year. Fire melts fusible link, closing valve instantly. In emergency, valve may be closed manually by remote control or by pressure or failure of air . . . thus preventing the spread of fire.

GREENWOOD Triple-Action Quick-Closing Valves are regularly made of cast steel with stainless steel trim. For chemical, acid, or other special services these valves can be furnished in monel, stainless steel or other alloys with proper trim for the particular service. Available in 1", 2", 3", 4", 6" and 8" pipe sizes.

VALVE MAY BE CLOSED 3 WAYS

1. FIRE MELTS FUSIBLE LINK.
2. REMOTE MANUAL CABLE CONTROL.
3. APPLIED AIR PRESSURE OR AIR FAILURE.

GREENWOOD Triple-Action Quick-Closing Valves in use on pressure storage tanks where highly volatile products are stored



PATENT PENDING

GREENWOOD TRIPLE-ACTION QUICK-CLOSING VALVE

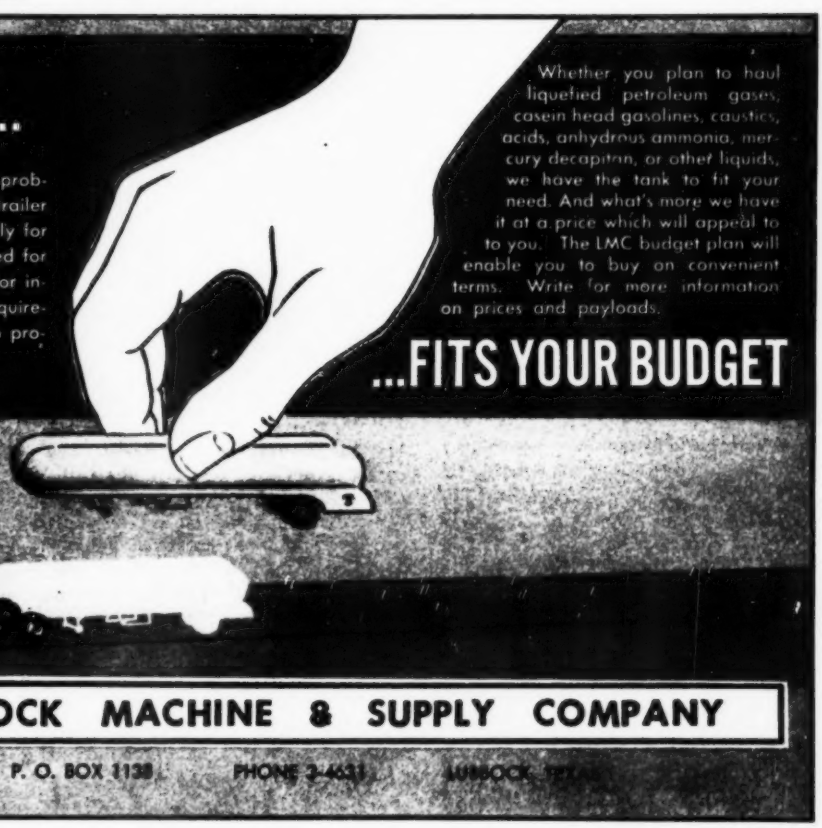
GREENWOOD VALVE DIVISION
VERNON TOOL CO., LTD.

1091 Meridian Ave. Alhambra, Calif.
P. O. Box 7555 Houston 7, Texas

Write for copy of Bulletin GV-3 showing the complete line of GREENWOOD Valves

FITS YOUR JOB...

No matter what your liquid hauling problem, we can help you. Each tank trailer manufactured is designed specifically for a particular job. Each is engineered for the product . . . for the truck . . . for individual state highway and ICC requirements . . . and each is designed to provide a maximum pay load.



Whether you plan to haul liquefied petroleum gases, casein head gasolines, caustics, acids, anhydrous ammonia, mercury decapitron, or other liquids, we have the tank to fit your need. And what's more we have it at a price which will appeal to to you. The LMC budget plan will enable you to buy on convenient terms. Write for more information on prices and payloads.

...FITS YOUR BUDGET

LMC LONE MOUNTAIN CORP.

LUBBOCK MACHINE & SUPPLY COMPANY

P. O. BOX 1138 PHONE 2-4631 LUBBOCK, TEXAS

Catawissa
PERFECT SEAL
Unions

HOT FORGED from solid, rectangular steel bars, designed and produced for dependable, long-life service under the severest piping conditions!

A TYPE FOR EVERY USE!
FOR ALL PRESSURES!
FOR ALL TEMPERATURES!

Standard & Double Extra Heavy
UNIONS
Available with screwed or socket weld ends. 3000-lb. sizes ⅛" to 3"; 6000-lb. sizes ⅛" to 2".

ORIFICE UNIONS
With screwed or socket weld ends. 3000-lb. and 6000-lb. service.

MALE & FEMALE UNIONS
With steel-to-steel, bronze-to-steel, stainless steel-to-steel or orifice seats. 3000-lb. service only.

Standard & Double Extra Heavy
LUG NUT UNIONS
Hammer-type for quick opening and quick closing.

write for your free copy of
CATALOG 11
for complete information

CATAWISSA VALVE AND FITTINGS COMPANY
25 Mill St. — CATAWISSA, PA.

herent in the mass production of highly engineered products—many of which didn't exist 20 years ago.

- Then, there are great hazards of obsolescence.

So much for the basic causes of increased demand. How about the supply?

In that same period, our management pool didn't expand to the same degree. The war effort killed a certain number of experienced managers. In addition to those who died in service, there was a significant number who died prematurely from overwork and nervous strain. There were additional numbers incapacitated, again, both in and out of service. The men who returned from service able-bodied, had serious gaps in their experience backgrounds. Four- and five-year shortages were fairly common among the 30-year olds, while the college grads were in many cases unable to start up the experience ladder in the normal manner because of established families. A smaller group couldn't face the transfer from supervisory positions in the military organization to the bottom rung of the business ladder. Many of these are lost for good.

Putting this subnormal supply of seasoned management against the great demand of this boom period—or even greater demands of a deflationary economy—leaves a big gap unfilled.

This article is from "The Executive Development of Engineers," presented at the 28th Annual Fall Meeting of the California Natural Gasoline Association.

Executives' Health

Continued from Page 246

Ultimately, it will destroy your health as well as your efficiency.

If you feel that you can't drop your business concerns at the end of the working day, I'd suggest that you develop some hobbies. To make recreation time real recreation, hobbies should be distant from your work interests. They will not only be valuable now, they will increase in value as you grow older and near the day of your retirement.

About your work habits, as about all daily habits, my best advice to you is to be moderate. In all things, moderation gives you a better chance of good health and happiness.

(To Be Continued)

THIS ACTUALLY HAPPENED!

Accidents seldom happen to experienced, attentive employes, no matter how hazardous their jobs. Here is another case history revealing why compensation insurance rates are so needlessly high.

The Accident: Employe mounted 500 barrel tank to disassemble it. Corroded deck gave way and he fell 16 feet to tank bottom, suffering fracture of left heel bone and causing him to lose 63 working days.

Recommendation: Do not go on tank roofs except when absolutely necessary. Planks should be laid on roof to increase bearing surface if there is reason to believe there is danger in walking on it.

The Courts Say

Continued from Page 244

The Texas Court said the controlling point is whether there was a connection between the assault made and the employment of employe. We are unable to distinguish an assault made by a union man against a non-union employe and an assault made by a union official on a member who continues employment without paying delinquent dues. There has, therefore, been a sufficient showing of a connection between employe's employment and his injuries.

—Aetna Casualty & Surety Co. v. England 212 SW 2nd 964 (Tex. Civ. App., Beaumont, 1948)

What Suppliers Are Doing . . .

Shedd Receives Appointment as Dempster Sales Representative

Dempster Brothers, Inc., Knoxville, Tenn., has announced the appointment of Ken J. Shedd as district sales representative in its north Middle Western territory.

Shedd

The new district representative will maintain offices in Tulsa. Before his appointment by Dempster, Shedd was a sales manager of the Load Packer division of Gar Wood Industries, Inc.

Dempster Brothers manufactures materials handling equipment and scrap metal baling presses.

Fats and Oil Specialist Joins Votator Division of Girdler

W. Doss Lumpkin has been appointed to the sales staff of the Votator division of The Girdler Company, Louisville, Ky. He is widely known in the fats and oils industry, and is a specialist in processes and equipment. He will be associated with the division's Fats and Oils section.

Lumpkin

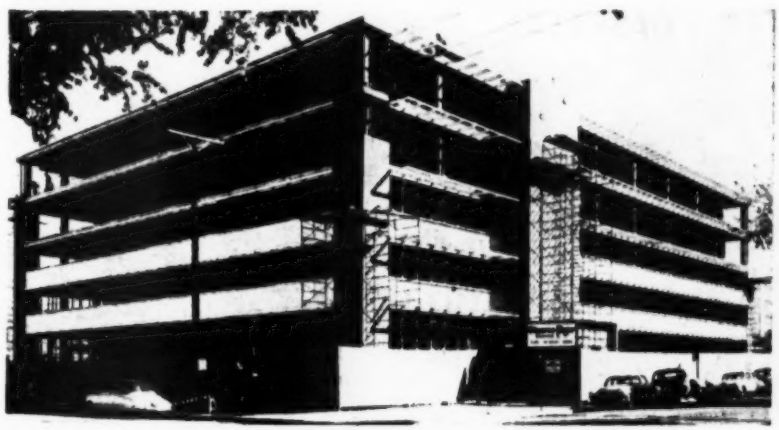
Lumpkin began his business career with Phillips Petroleum Company. He resigned in 1941 to join the Filtrol Corporation, where he headed the company's field activities in the fats and oils industry before becoming a member of Girdler's organization.

Minneapolis-Honeywell Adds 16 to Division Sales Force

Sixteen sales engineers were recently added to the field sales force of Minneapolis-Honeywell Regulator Company's Industrial division in 12 branch offices located in 11 U. S. cities and 2 Canadian cities.

At the same time, 20 service engineers, were added to the firm's field sales force, taking assignments in 17 U. S. cities and 2 Canadian cities.

The new appointees include: K. J. Lesker, Dallas; O. E. Krienke, New Jersey; W. J. Boschert, St. Louis; W. G. Henderson, Chicago; R. P. Norton, Indianapolis, Ind.; W. J. Young, Houston; W. C. Curp, Dayton, Ohio; W. T. Lisenby and J. T. Gentry, Los Angeles; J. L. Ciprari, Minneapolis, Minn.; K. Batchelor, Houston; W. L. Bolton, Atlanta, Ga.; R. J. Raycroit, Toronto; T. M. Hunt and W. F. Harrison, Montreal, and H. E. Allison, International division.



Stearns-Roger Builds One for Itself —

Stearns-Roger of Denver, Colo., which has created such facilities for others for many years, has engineered and constructed for itself a new home office building at Denver. The firm will soon move into the large plant which will have 90,000 square feet of floor space.

As large contractors usually establish operations offices at the job site, Stearns-Roger has leased its central office to permit expansion or contraction or even movement from place to place. An outstanding feature of the new building is the system of horizontal metal louvers which reduce light glare through the lightly-tinted, heat-absorbing glass.

Black, Sivalls & Bryson Name Louisiana Branch Managers

Two new managers of recently opened branches of Black, Sivalls & Bryson, Inc., have been appointed. Ray R. Noland, former serviceman at Houston, has been appointed manager of the new Harvey, La., branch, and Louis Morgan, formerly at Lafayette, La., has been named to a similar post at the Lake Charles, La., branch.

Noland Morgan

U. S. Steel Assigns Burns to Fairless Works PR Position

Frank A. Burns, director of public relations in United States Steel Corporation's Pacific-Southwest district in Los Angeles, has been appointed public relations representative at the corporation's Fairless Works in Bucks County, Pa. As head of the field office at Fairless Works, he will maintain close liaison with the newly established Philadelphia district office, of which John J. Appleyard recently was named director.

Before joining U. S. Steel as assistant to the director of public relations for Columbia Steel Company in 1942, Burns was with Santa Fe Railroad.

W. R. Dand Licensed to Make Gorman-Rupp Pumps in Canada

Gorman-Rupp Company has licensed W. R. Dand Petroleum Equipment, Ltd., of Toronto, Ontario, to manufacture Gorman-Rupp pumps for petroleum transfer and refueling service in Canada.

Dand

Dand will begin production early this year. Plans have been approved and contracts let for a new plant in Toronto.

Head of the licensed company is W. R. Dand, who has been a Gorman-Rupp pump distributor for 20 years. His company specializes in all types of equipment for the petroleum industry.

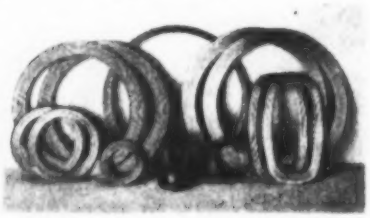
Celanese Assigns Reynolds and Harkness to Plastics Division

C. M. Reynolds, formerly assistant district manager of the Midwest sales territory of Celanese Corporation of America, has been named assistant director of sales in the corporation's Film department, Plastics division. He will be replaced in the Midwest sales territory by Peter J. Dunn.

Taylor Forms New Subsidiary

Taylor Instrument Companies recently established a new Taylor subsidiary in Australia known as Taylor Instrument Companies of Australia Pty., Ltd. W. E. Kirkby, sales manager of

Need Plain or Jacketed
CORRUGATED METAL
GASKETS?



Call CHICAGO-WILCOX
for PROMPT ATTENTION

Chicago-Wilcox understands the gasket requirements of refineries and is equipped to supply all types of gaskets, including plain or jacketed corrugated metal gaskets like these. Made of ingot iron, aluminum, stainless steel, copper, brass, nickel, and monel in all sizes and shapes.

Send specifications for quotations and prompt-delivery schedule.

CHICAGO-WILCOX MFG. CO.
2701 Avalon Avenue, Chicago 19, Ill.
Phone SAginaw 1-1900

See Page 235 in Refinery Catalog

JET-LUBE
VL-5
VALVE LUBRICANT

WITH MOLY-DISULPHIDE

High temperature, non-melting silica base valve lubricant with low friction moly-disulphide. Use JET-LUBE VL-5 on valves that are hard to turn. Resistant to hydro-carbons, water, acids, sulphur and alkalies. Batch controlled. Fully guaranteed.

Order through your supply store or send for complete details

JET-LUBE INC.
7362 W. BEVERLY BLVD., LOS ANGELES 36

Suppliers . . .

Taylor's English subsidiary, Short & Mason, Ltd., has been appointed managing director of the new company.

Hinnes Made Service Manager Of New Marlow Department

Marlow Pumps, Ridgewood, N. J., has announced the appointment of Harold Hinnes as manager of the company's newly created Service department.

Hinnes

Reorganization of service facilities into a separate department will concentrate added attention on this phase of the company's business. The new department will act directly for dealers and customers to provide specialized attention to all requests for parts, repairs, and service information.

Pyrene Names Ratzer and Laswell Vice Presidents

Arthur F. Ratzer and Maynard A. Laswell have been named vice presidents of Pyrene Manufacturing Company.

Ratzer first joined The Pyrene Company, Ltd., in London in 1935. He was transferred to the parent company in the U. S. in 1950 as manager of the Foam Engineering department. Since February, 1953, he has been executive assistant to the president. He is also president of Chemical Concentrates Corporation.

Maynard A. Laswell is also vice president of C-O-Two Fire Equipment Company, affiliate of Pyrene. At Pyrene he will be in charge of sales. With Laswell as vice president of both companies, sales, advertising and merchandising for products will become unified.

Contract Awarded for Part Of Lukens Armor Plate Plant

Moseman Construction Company, Inc., has been awarded the contract for the first construction phase of the $10.5 million armor plate heating plant and allied facilities to be built on Lukens Steel Company property. Moseman submitted a low bid of $705,620.

Phase One will involve relocation of a creek that runs through the plant site and construction of a 5-million-gallon capacity reservoir and brick pump house.

Gates and Punton Advanced By Mine Safety Appliances

William H. Gates has become manager of the Southwest district, and Charles W. Punton director of engineering in appointments announced by Mine Safety Appliances Company.

Gates, assistant manager of the Southwest district for the past year, succeeds Harry W. Richards, deceased. Gates has been with the company since 1938.

Punton has been with it since 1929, starting as an industrial engineer. He was named works manager in 1941.

Regional Managers Named in Appointments at A. O. Smith

Appointments of regional managers of the East and West Coast district offices of A. O. Smith Corporation have

Stake

Dragge

been announced.

Walter W. Stake, formerly assistant general sales manager for the Permaglas-Heating division in New York, has been named to the Eastern district post.

Allen O. Dragge, who has had jurisdiction over the West Coast operations, now has been named to the Pacific Coast district post.

Stake has been in the New York offices since joining the company in 1945.

Dragge joined A. O. Smith in 1947 and has since been in the Pacific Coast division.

In another appointment, Charles E. Heitman, manager of the Automotive division, has filled the newly created post of assistant to the general manager of the company. For the near future Heitman will continue to head the Automotive division but later he will be called upon to assist the general manager's office in company-wide matters.

The new assistant general manager has been with A. O. Smith since 1940, has managed the Automotive division since 1946.

Three Receive Appointments At American Car and Foundry

American Car and Foundry Company has announced the following changes in its Western Sales area:

John H. Van Moss, Western sales manager at Chicago since 1938, has become sales consultant for the Western territory with headquarters at Chicago.

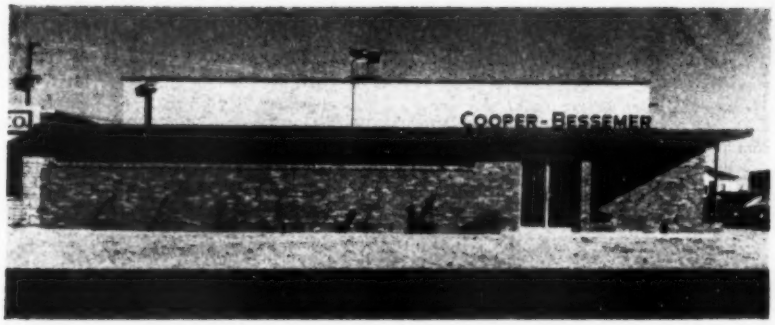
Ellsworth B. Carpenter, district sales manager at St. Louis, has been named western sales manager there, with jurisdiction over the Chicago, St. Louis and San Francisco sales offices.

John E. Angst, assistant Western sales manager, has been advanced to district sales manager at Chicago.

General American Will Operate Phillips Terminal at Houston

General American Transportation Corporation has purchased and will operate the tank storage terminal of Phillips Petroleum Company at Pasadena, Texas, Port of Houston. The Pasadena terminal becomes the fourth terminal in Texas and the seventh in the U. S. operated by General American.

W. A. Buckner, superintendent of General American's terminal at Galena Park, Houston, Texas, will supervise the new terminal operation. General American is building an additional 1,170,000 barrels of tankage to go with the present capacity of 510,000 barrels.



Cooper-Bessemer Builds At Odessa—

Expanded field service facilities are housed in The Cooper-Bessemer Corporation's new brick building at Odessa, Texas. Under the direction of A. W. Abel, branch manager, the new structure embraces 1715 square feet of office space and 3725 square feet of warehouse area. The new building is part of Cooper-Bessemer's program to form an even closer working relationship between the factory and users of diesel and gas engines and compressors.

New Division General Managers Named by American Cyanamid

In changes in the managerial organization of American Cyanamid Com-

Klipstein Duncan

pany, Kenneth H. Klipstein has become general manager of the newly created Research division and L. C. Duncan has become general manager of the newly formed Organic Chemicals division.

The new Research division is responsible for the operation of the Stamford Research Laboratories under the direction of Dr. J. T. Thruston and supervises other research and development programs not the direct responsibility of operating divisions. It coordinates these programs with related activities of the operating divisions.

The new Organic Chemicals division was formed through a merging and consolidating of activities of the Petrochemicals division and those of the Calco Chemical division.

Leeds & Northrup Changes Move Trueblood to Milwaukee Office

Leeds & Northrup Company has announced the promotion of two sales field engineers to district managerships, a change in territory for another manager, and the opening of a new branch office in Milwaukee, Wis.

Wilson D. Trueblood, Jr., formerly in the Leeds & Northrup Chicago office, becomes district manager of the new five-man office at Milwaukee.

Edwin A. Yeo, for 16 years the firm's Cincinnati manager, becomes manager at Pittsburgh, replacing the late Harold S. Vecella.

Willard H. Neu, formerly a sales field engineer in the Pittsburgh office, becomes district manager at Cincinnati.

McNamara Elected President And Board Chairman of Alox

James F. McNamara has been elected chairman of the board and president of Alox Corporation, New York. This follows the recent purchase of control of Alox by Surpass Petroleum Ltd., of Toronto, of which McNamara is chairman of the board.

McNamara resigned recently as a vice president of The International Nickel Company, Inc., with which he has been associated for over 42 years, but he will continue to serve that company as a consultant.

B&W and Seaboard Join on Manufacture of Refractories

Under a manufacturing agreement recently concluded between The Babcock & Wilcox Company, New York, and Seaboard Refractories Company, Raritan Township, N. J., Seaboard's entire manufacturing facilities will be devoted to producing special refractories for Babcock & Wilcox. Seaboard will discontinue its own sales activities; sales will be handled by B&W.

The Refractories division of Babcock & Wilcox now manufactures and markets special refractories.

Diserens Retires from Worthington After 45 Years

Paul Diserens, consulting engineer and, until 1952, director of research and development of Worthington Corporation, has retired from the company in the forty-fifth year of his service to Worthington.

At a testimonial luncheon given in his honor, Diserens received a 45-year service pin, a television set from his associates at Worthington, and heard himself cited as being "loyal beyond measure" to his associates and to his company. Diserens joined Worthington in 1909 as engineer of test in charge of research at its Cincinnati, Ohio, Works.

Titeflex Filter Rights Sold To Croll-Reynolds Company

Titeflex, Inc., Newark, N. J., has sold the design and manufacturing rights of the Titeflex industrial filter for the chemical and processing markets to Croll-Reynolds Engineering Company.

Suppliers . . .

Darling Valve Appoints Evans Eastern Regional Sales Head

M. Stuart Evans has been appointed Eastern regional sales manager by Darling Valve & Manufacturing Company. Evans joined Darling as the Tulsa district representative in 1950.

Evans

At the same time Darling announced the appointment of Joseph T. Cowan as district representative in Tulsa, replacing Evans. Cowan has been a resident of Tulsa for some time. His previous experience has been in the oil, gas and public utility industries in the Southwest.

Pacific Pumps Announces Four Executive Advancements

In appointments recently announced by Pacific Pumps, Inc.: A. F. Canada, Jr.,

Canada Graham Bahler

Jr., formerly Mid-Continent regional manager for the Centrifugal Pump Division, has become sales manager of that division; G. F. Graham, formerly assistant sales manager of the Plunger Pump Division, has been named sales manager of that division; Walter J. Bahler, Tulsa sales engineer, has been named manager of Pacific's Tulsa office, Centrifugal Pump Division, and J. W. McCormick, a Pacific sales engineer in California and New York for the past 12 years, has been advanced to assistant manager of the Centrifugal Pump office in New York.

New Straus-Frank Division Has Complete Stock Library

Straus-Frank Company has established a new Engineered Products division at Houston under the direction of Ben Collins, vice president of the company. The new division will serve as a distributor for the petroleum and chemical industries in the southern half of Texas and Louisiana.

Lines to be carried by the new division include: link radio equipment for mobile, pipe line and general communications; Hamarlund supervisory control and telemetering equipment; laboratory and research instruments; gaging systems; process analytical equipment;

Suppliers . . .

and General Electric and Westinghouse electronic equipment. An outstanding feature of the new division is a complete library of detailed engineering information on every item in stock. The library will be open to industry engineers.

Elliott Appoints Thayer Cincinnati District Manager

Raymond V. Thayer has been appointed Cincinnati district manager for the Elliott Company.

Thayer

A native of Chicago, Thayer received his degree in mechanical engineering from Purdue University in 1941, and, immediately following his graduation, served four years in the Field Artillery, attaining the rank of captain.

He joined the Elliott Company in 1945 as a field engineer in its Cincinnati office, in which capacity he served until his present appointment.

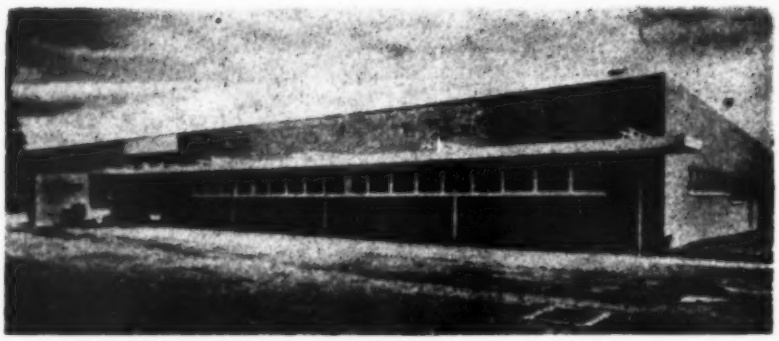
Jones & Laughlin Division Opens Oil Field Supply Store

A new oil field supply store has been opened by Jones & Laughlin Steel Corporation—Supply division at Newcastle, Wyo. It becomes the fourth store point in the recently expanded Southern Rocky Mountain district of the division.

Robert R. Brown, formerly store manager at Laurel, Miss., has been transferred in the same capacity to Newcastle. He will be assisted by Lester L. Reed and Dean E. Armstrong, salesmen; and Donald M. Thorwart, Eddie H. Hendricks and Paul C. Owens, storemen.

Colvin Wins Oakite Award—

The 1953 D. C. Ball Award, presented annually in memory of the founder of Oakite Products, Inc., was won by Robert J. Colvin, Oakite representative in Syracuse, N. Y., since 1942. John A. Carter, president of Oakite, is shown above, at left, presenting the award to Colvin. Oakite presents the award annually to its representative who has rendered exceptional service to industry.



France Packing Expands into New Plant—

This new building is the latest outgrowth of France Packing Company's growth. Unable to expand further a plant which it had operated for over 50 years, the Philadelphia company built the above plant on a 15-acre site which will permit future expansion.

To commemorate the move into new and larger quarters, the company has issued a booklet entitled "The France Story" which is illustrated with both cartoons and actual photographs.

Three Representatives Assigned By Industrial Filter & Pump

Industrial Filter & Pump Manufacturing Company, Chicago, has appointed

Dawson Valentine Filkins

the following factory district representatives in sales and service engineering for its products:

George J. Dawson, who, before joining the company, was a staff chemist with Infilco, Inc., will cover Pennsylvania and western New York from branch offices in Pittsburgh and Philadelphia.

Gil Valentine, formerly sales and service engineer in the Plating Chemicals division of McGean Chemical Company, will cover Michigan from the Detroit branch office.

James Filkins, formerly analytical and development chemist for Pure Oil Company, will cover Texas and Oklahoma from the Dallas branch office.

The branch offices from which the representatives will work are all new.

Logelin Succeeds Wilby as U. S. Steel Vice President

Arthur C. Wilby has retired as vice president of United States Steel Corporation in Chicago and has been succeeded by Edward C. Logelin.

Before becoming vice president in 1946, Wilby was for eight years director of public relations for U. S. Steel in the Chicago district.

Since joining U. S. Steel in the Advertising department of Universal Atlas Cement Company in 1930, Logelin has held a succession of public relations posts. He succeeded Wilby as director of public relation in 1946.

Checkley Named to Manage New Arthur G. McKee Division

A new Industrial Engineering division has been formed by Arthur G. McKee & Company, Cleveland, to handle engineering contracts for industries other than the steel and petroleum. David M. Checkley, formerly vice president of J. Gordon Turnbull, Inc., has been appointed general manager of the new division.

Checkley

Starting his career with North American Aviation Company, Checkley joined J. Gordon Turnbull Company in 1944, advancing to vice president in 1951.

Rockwell Opens New Addition To Gas Meter Plant at Du Bois

Rockwell Manufacturing Company has opened a new 19,000-square-foot addition to its gas meter plant in Du Bois, Pa.

The one-story brick-and-tile structure, which will house manufacturing facilities for the company's large-capacity industrial gas meters, is the second Rockwell expansion to be completed in the Du Bois area within the past three months. Additional gas meter manufacturing and storage space was provided by construction of an 11,000-square-foot building at nearby Sykesville, a project completed in last September.

Arthur D. Little Schedules San Francisco Office Opening

A Western regional office will be opened in San Francisco early this year by Arthur D. Little, Inc., under the direction of Christian J. Matthew, veteran employe of the company. Richard Newhall will be an associate in the new office.

Since joining ADL in 1942, Matthew has been active on projects involving both scientific studies.

Wolverine Tube Relocates Two Sales Representatives

The Wolverine Tube division of Calumet & Hecla, Inc., has relocated Sam

Robb Robertson

Robb, formerly of the general sales office in Detroit, at the division's headquarters in New York. W. G. Robertson, also formerly of the general sales office, has been transferred to the Rochester, N. Y., office.

Two Associated Companies Merge Into One Organization

Merger of associated companies, Wallace and Tiernan Company Inc. and Novadel-Agene Corporation, into a single organization known as Wallace & Tiernan Inc., has been completed. Subsidiaries of the new company include W. C. Hardesty Company Inc., Richmond Manufacturing Company, Thomson Machine Company, Electro Rust-Proofing Corporation (New Jersey) and Wallace and Tiernan, Ltd.

Schwanhauser Gives Main Talk At Cuno Sales Conference

Cuno Engineering Corporation recently held its biannual sales conference at Pine Orchard, Conn. Edwin J. Schwanhauser, executive vice president of Worthington Corporation, was the keynote speaker.

Topics discussed by management and representatives at the five-day meeting were product developments, new products and markets, application engineering and trade talks.

Westinghouse Electric Plants Set Safety Records in 1953

The 18,000 men and women of Westinghouse Electric Corporation's East Pittsburgh divisions have completed the safest year in the plants' 58-year history. The employes worked a total of more than 37.5 million hours with an accident frequency rate of 1.9 and an accident severity rate of only 0.10. (Frequency rate represents the number of lost time accidents per million man hours worked, and severity rate represents the number of days lost because of accidents per thousand man hours worked.)

According to the latest figures from the National Safety Council, industry in general has a frequency rate of 8.4 and a severity rate of 0.88.

Several outstanding divisional safety records were also made in 1953. Westinghouse's entire Switchgear division worked from January 14 to May 20—a total of 3,472,196 hours—without a disabling injury. The Transportation and Generator division worked from July 27 to October 27, a total of 3,300,950, without a lost-time injury.

Suppliers . . .

Norton Appoints Two to Refractory Sales Positions

Norton Company, Worcester, Mass., has announced two appointments in its

Winemiller Miller

refractory sales organization: William F. Winemiller to manager of the Sales Engineering department of the Refractories division, and James L. Miller to refractories engineer, responsible for a new territory which consists of Missouri and all of Illinois south of Chicago.

Winemiller, formerly chief sales engineer, has been with Norton since 1947.

Miller has been with Norton since

GARY
Welded Grating

with Hexagonal Cross Bars

● This one-piece grating features design, construction, and appearance. The main bearing bars and the hexagonal cross bars are welded, insuring a durable unit. Our method of manufacture results in the tops of all bars being flush.

This particular design of welded grating is made with the main bars on 1-3/16" centers or .915 centers and the cross bars on 4" centers in panels 24" or 36" wide, and lengths to 40'-0".

Special gratings can be furnished with cross bars spaced on 1½"—2½" or 3" centers.

Free SAMPLE

If you will write to us on your company stationery, giving title, we will send you a paper weight size sample.

GARY-GRATING • GARY-STAIR TREADS
GARY-IRVING DECKING

• Representatives in all principal cities. Consult your telephone directory.

STANDARD STEEL SPRING DIVISION
ROCKWELL SPRING AND AXLE CO.
4011 EAST SEVENTH AVENUE GARY, INDIANA

ARE YOU SWITCHING TO KING SIZE STACKS?

If you are planning new additions for your present operation or new installations, then you might be interested in knowing that John Dollinger, Jr., Inc. is prepared to offer you complete fabrication service on steel plate work. Our new plate and turning roll equipment facilitates fast accurate fabrication of stacks and duct work, large or small.

FOR OVER 50 YEARS, LEADERS IN THE OIL INDUSTRY HAVE LOOKED TO JOHN DOLLINGER, JR., INC. FOR QUALITY STEEL FABRICATION AND DEPENDABLE DELIVERY.

ST DOLLINGER
AROUND THE WORLD.

For inquiries regarding fabricated structural steel and plate steel, write to
John Dollinger, Jr., Inc.
Beaumont, Texas

Suppliers . . .

1951. Prior to his present appointment, he was a member of the Refractory Sales Engineering department.

James K. Stevenson will continue to handle all refractory accounts in the northern half of Chicago, the northern part of Illinois and the states of Iowa, Wisconsin and Minnesota.

Oakite Representatives Meet

A series of three regional technical-sales conferences was recently held by field service representatives of Oakite Products, Inc., in San Francisco, Chicago and New York. Problems discussed were higher operating costs and more complex processes.

GUNITE
Since 1915
CONCRETE
SAND AND CEMENT
Placed by Air

We own and operate 43 complete cement gun outfits. We have completed over 2600 exclusive GUNITE contracts.

Send for specifications and bulletins
No obligation

See our catalog in Sweets

GUNITE CONCRETE & CONST. CO.
1301 WOODSWETHER RD., KANSAS CITY 5, MO.
7016 W. WALNUT, CHICAGO 12, ILL.
7036 ADDISON, HOUSTON 25, TEXAS
St. Louis · Minneapolis · Denver · New Orleans

it makes sense to save
POWER PLANT DOLLARS with
SAND-BANUM
Pure Colloidal Concentrate
Ounces Only
Once a Week
REMOVE AND PREVENT
SCALE AND CORROSION
Stocked by Leading Supply Houses
Literature on Request
AMERICAN SAND BANUM CO.
[illegible] Rockefeller Plaza
[illegible] York 20, N.Y.

Edwards and Miller Get New Posts at Green Company

L. L. Edwards has become general manager of A. P. Green Fire Brick

Edwards Miller

Company's new district representative and distributor organization, A. P. Green Fire Brick Company of Texas. Edwards has been associated with the Green organization for over 25 years, during which time he has been connected with various phases of its operation, including factory, office, sales territory, and as an executive in distributor organizations.

In another personnel appointment at the A. P. Green Company, Ed C. Miller has been named district sales manager of the Indianapolis office. During the many years he has been associated with the company he has served primarily in a sales capacity. Prior to his recent appointment he was sales supervisor at the Mexico, Mo., office.

Company Changes

J. H. Ruskin has been elected executive vice president of **Chemical Construction Corporation.** At the same time **G. I. Seybold** and **Martin de Simo** were elected vice presidents and **Thomas P. Forbath** was named assistant to the president. Ruskin joined the parent firm, American Cyanamid Company, in 1947 and served until his election as general manager of the Petrochemicals division. Seybold, de Simo and Forbath had held executive posts with Chemical Construction . . . **John W. Pew,** formerly district manager for the Houston sales area of **Hewitt-Robins, Inc.,** has been named manager of the seven-state South Central Sales division, with headquarters in Houston. **R. E. Johnson,** field engineer in the company's Virginia district, has been appointed manager of the Houston district. Pew began with Hewitt-Robins in 1936 . . . **Howard F. Schnepp,** who joined **The Dow Chemical Company** in 1940 and has recently been in the Detroit office, has moved to the company's home plant and office at Midland, Mich., where he will be in the molding powders section of the Plastic Sales department. Replacing Schnepp in Detroit is **F. V. Duffy,** who recently completed a sales training program at Midland. **F. C. Sullivan,** a coating salesman, has been added to Dow's Minneapolis, Minn., office.

Donald W. Frison, formerly assistant sales promotion manager of the Petroleum Chemicals division, has been appointed assistant manager of the Mid-Continent district of that division of **E. I. du Pont de Nemours and Company, Inc.** He has been with Du Pont since 1947 . . . **E. T. Wilson, Jr.,** has been appointed sales representative of the Tubular Products division of **The Babcock & Wilcox Company** for the Oregon, Washington, British Columbia, Alberta and Saskatchewan area. He was previously with Cascade Manufacturing Company . . . **Brown Fintube Company,** Elyria, Ohio, has licensed **Friedrich Uhde GMBH,** West Germany, to manufacture and sell Brown's products in West Germany and other countries in Europe, Africa and the Middle East . . . **A. G. Ricketts,** who began with **Rockwell Manufacturing Company** 21 years ago as a storeroom clerk, has been transferred to the company's Oakland, Calif., plant. He has been supervisor of the Sales Order department of Rockwell's Nordstrom Valve division since 1950 . . . **Russell H. Dunham,** first president and former chairman of the board of directors of **Hercules Powder Company,** has retired from the company after 51 years of service. He will remain a member of the company's board and finance committee . . . **Charles B. Baker,** executive vice president of **Universal Atlas Cement Company,** a subsidiary of United States Steel Corporation, has succeeded **Blaine S. Smith,** retired, as president of the company. Smith, who has been associated with Universal Atlas for more than 37 years, continues with the company in a consulting capacity.

George G. Zipf, formerly assistant superintendent of the steel plant of **The Babcock & Wilcox Company's** Tubular Products division, has been appointed superintendent of the plant. Zipf joined Babcock & Wilcox in 1942 . . . **L. A. Kilgore** has been appointed staff engineering manager for **Westinghouse Electric Corporation's** East Pittsburgh division. Prior to his appointment he was assistant manager of generator engineering for the East Pittsburgh plant's Transportation and Generator division. In his new post he will direct the engineering laboratories and help direct the design and development work of the electrical generating and distribution apparatus produced at the plant . . . **William B. McCloskey,** vice president of **The Davison Chemical Corporation** since May, 1953, has been given the responsibility of the operational groups of the company, which include engineering, production, traffic, purchasing and industrial relations . . . **Davis E. Speeg,** experienced in water treatment, has joined **Coastal Engineering Corporation.** He will serve manufacturers of industrial equipment in the field of industrial water conditioning . . . **Charles C. Gallicano,** formerly administrative assistant to the president's office at **American Car and Foundry Company,** has been appointed assistant to the president of ACF. Though he joined ACF in 1948, Gallicano has only recently returned there from service in Korea.

Enterprise Brass Works, Muskegon, Mich., has established an Oil Equipment Sales division and is marketing a line of valves, fittings and accessories for the oil industry . . . **Sims Pump Valve Company,** Hoboken, N. J., has appointed **Nutmeg Industrial Supplies, Inc.,** as the exclusive distributor of Sims products in Connecticut.

Bailey Boston Office Moves

The Boston district office of Bailey Meter Company of Cleveland has moved to new quarters at 230 CongressStreet. P. T. Reuter is manager.

HELP WANTED

Equipment Inspectors

(Age: 25-35)

Desired by major oil company for career opportunities in South America.

Will inspect fired and unfired vessels both pressure and atmospheric, fire tube and water tube boilers, furnaces, fractionators, drums, tanks, piping, safety valves, etc., associated with refinery operations. Should be familiar with ASME, API, and ASA codes. Good opportunity for advancement. Minimum requirements: Degree in engineering, preferably mechanical, plus 2 years experience in refinery equipment inspection. Non-degree men with upwards of 5 years refinery experience may be considered. Salary plus bonus: $8,000-$10,000. Also liberal benefits, tax savings and home vacations with traveling expenses. Replies confidential.

Box 1540
Dept. A-1
General Post Office
New York 1, N. Y.

FOR SALE

GLASSES & GASKETS

ALL SIZES TO FIT YOUR GAGES & VALVES
ERNST WATER COLUMN & GAGE CO.
***Send for Catalog,* LIVINGSTON, N. J.**

For Sales **3500 Tons**
PORTABLE STEEL IRVING GRID
AIRFIELD OR ROAD MATS
Ideal on sand, dirt or mud
Will be sold in any quantities
Rail and Barge Shipping Facilities
ALTER CO. **Davenport 16, Iowa**

■ Pipe still salvage, up to 600 P.S.I. valves and fittings, 2000 brass ⅝" x 4" bolts and nuts, reaction chamber 40' long 4½' diameter 4" thick 900 lb. pressure, high pressure pumps. Kell Jones & Son, Lee and Irving Sts., Beaumont, Texas.

Suppliers . . .

Blaw-Knox Assigns Additon to Philadelphia in Sales Post

E. P. Additon has been appointed sales engineer for the Mid-Atlantic district by Blaw-Knox Company, Chemical Plants division. He will be located at the Philadelphia office, and will offer services of the company to clients in a five-state area.

Prior to his present assignment, Additon held sales and engineering positions in the Chemical Plants division over a ten-year period, and had earlier employment with Barrett division of Allied Chemical and Dye Corporation, and Calco division of American Cyanamid Company.

Three Receive Appointments In American Brake Shoe Sales

The American Manganese Steel division of American Brake Shoe Company has appointed John Brandenburg vice president in charge of sales, William E. Crocombe, Jr., central sales, and John H. Baker district sales managers.

Brandenburg, formerly sales manager for the Amsco division, joined the company in 1930. Crocombe joined the company as an operating trainee in 1937. Prior to his new appointment he was district sales manager in St. Louis. Baker, formerly a sales engineer with Amsco, joined the company in 1947.

PETROLEUM REFINER Classified Ads

RATES: Regular Classified (undisplayed) set in this size type, 10 cents per word. Minimum charge, $3. Blind box address in our care counts six words. Replies forwarded without charge. **Display ads,** set in suitably larger type with ruled border, $10 per column inch.

All classified ads payable in advance. Ten percent discount for two or more insertions of same copy in consecutive issues. COPY DEADLINE: 25th of month preceding date of issue. Send copy and remittance to: Classified Ad Department, Petroleum Refiner, P. O. Box 2608, Houston, Texas.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

HELP WANTED

HELP WANTED

Engineers with petroleum refinery operating experience. Several positions open to qualified engineers for field service duties in new refinery start-up and operations. Applicants must be willing to travel. All applications strictly confidential. Please send complete resume giving age, education, experience and salary desired to Box 179-R, Petroleum Refiner, Houston, Texas.

EQUIPMENT INSPECTION ENGINEERS

SOUTH AMERICA

A major oil company affiliated with Standard Oil Company (N. J.) needs graduate engineers with several years refinery process equipment inspection experience. Must be qualified to interpret codes and specifications, predict equipment renewals, and recommend replacement equipment.

Write giving age, marital status, education, and full details of experience.

Box 308-O
Radio City Station
New York 19, N. Y.

METALLURGICAL ENGINEERS

Work on the metallurgical problems encountered in oil-refineries and chemical-plants. These include analyses of corrosion problems, examination of failures, selection of materials of construction, experimental studies, and the development of fabricating methods for ferrous and non-ferrous metals.

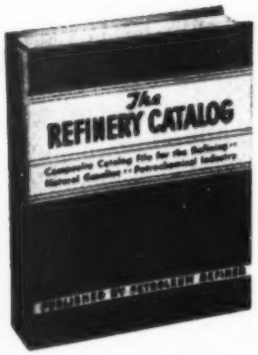
Three or more years experience are preferred. Please send your resume to our Personnel Department. Your letter will receive immediate action and be kept in strict confidence.

C. F. BRAUN & CO.

Consultants *Fabricators* *Constructors*

ALHAMBRA, CALIFORNIA

Advertisers in the February Issue



*The asterisk preceding name of advertiser indicates that detailed data on products and services of the firm will be found in The 1953 Refinery Catalog.

A

*The Air Preheater Corp. 44
Air Reduction Magnolia Co. Opp. 229
*Aircotool Manufacturing Co. 202
Allied Chemical & Dye Corp. 11
*Allis-Chalmers Manufacturing Co. 28-29, 31
*Aluminum Company of America 234-235
*American Brass Co. 20
American Cyanamid Co. 53
*American District Steam Co. 62
American Locomotive Co. 76-77
American Sand-Banum Company 232
Appleton Electric Co. 170-171
Atlas Powder Co. 35
Avondale Marine Ways, Inc. 231

B

*The Babcock & Wilcox Co. 36-37
*Badger Manufacturing Co. 85
*Bailey Meter Company 33
*Baldwin-Hill Company 194
The J. B. Beaird Co. Insert 32-33
Beaumont Forging Co. 236
Bethlehem Steel Co. 79
*Black, Sivalls & Bryson, Inc. 57
*Blaw-Knox Company 184
Bonney Forge & Tool Works 34
*Bridgeport Brass Company 219
The Bristol Company 8
Brown & Root, Inc. 216
*Buell Engineering Co. 65

C

*Calumet & Hecla, Inc. 179
Catalytic Construction Co. 78
Catawissa Valve & Fittings Co. 250
Central Scientific Co. 32
The Chapman Valve Manufacturing Co. 42
Chase Brass & Copper Co. 182
Chemical Construction Corp. 60
Chicago Bridge & Iron Co. I Cover
*Chicago-Wilcox Mfg. Co. 252
*Clark Bros. Co. 48-49
Classified Ads. 257
Cleton Ltd. 180
The J. S. Coffin, Jr., Co. 183
Columbia-Geneva Steel Division
United States Steel Corp. 86
Conoflow Corp. 22
*The Cooper-Bessemer Corp. 174-175
*Corning Glass Works 248
*Crane Company 165
*Crane Packing Co. 193
*Croll-Reynolds Co. 200
Crouse-Hinds Company 30

D

*Dean Brothers Pumps Inc 188
De Laval Steam Turbine Co. 207
Dempster Brothers 71
John Dollinger, Jr., Inc. 235
Dowell Incorporated 215
*Dravo Corp. 209
*Dresser Industries, Inc. 221
*Dresser Operations, Inc. 48-49
E. I. du Pont de
Nemours & Co. Insert 64-65, 80
*The Duraloy Company 206

E

Eastman Chemical Products, Inc. 54
Electro-Snap Switch & Mfg. Co. 209
*Elliott Company 163
Enjay Company, Inc. 63
Ethyl Corporation Insert 16-17

F

*Farris Engineering Corp. 12-13
Fenwal Inc. 74
*Fisher Governor Company 47
*Flexonics Corp. 168
*The Fluor Corp. 10
*Food Machinery & Chemical Corp. 17
Foster Engineering Co. 180
*Foster Wheeler Corp. 41
The Foxboro Company 14

G

General American Transportation Corp. 83
*General Electric Co. 68-69
The Girdler Company 229
Claud S. Gordon Co. 226
Graver Tank & Mfg. Co. III Cover
*Grinnell Company 10
*Gulf Publishing Co. 231
Gulf States Asphalt Co. 224
Gunite Concrete & Construction Co. 256

H

*Hartzell Propeller Fan Co. 240
*The Howe-Baker Corp. Opp. 192
*Hudson Engineering Corp. Opp. 193

I

*Ingersoll-Rand Co. 7
The International Nickel Co. 30, 177

J

*The C. O. Jelliff Mfg. Corp. 231
Jet-Lube, Inc. 252
*Jones & Laughlin Steel Corp.
Supply Division 70

K

*Kennsbey & Mattison Co. 81
Wm. Kenyon & Sons, Ltd. 238
*The Key Company 186
Kilbourn Engineering Co. 214
Kinney Mfg. Division
The New York Air Brake Co. 208
Koppers Co. 198

L

Layne & Bowler, Inc. 25
*Warner Lewis Company 225
Lubbock Machine & Supply Co. 249
Lukens Steel Co. 38
*The Lummus Company 212, 239

M

Manning, Maxwell & Moore, Inc. 52
*Mason-Neilan Regulator Co. 16
The Master Electric Co. 39
*A. Y. McDonald Mfg. Co. IV Cover
*Arthur G. McKee & Co. 167
*Metal Goods Corp. 64
*Midwest Piping Company, Inc. 40
*Minneapolis-Honeywell Regulator Co. 72-73
*Mixing Equipment Co. 38
Samuel Moore & Co. 201
*Murray Iron Works Co. 176

N

*National Aircil Burner Co. 226
National Tube Division
United States Steel Corp. 86
The New York Air Brake Co. 208
Newport News Shipbuilding &
Dry Dock Co. 181
*W. H. Nicholson & Co. 4
Nitrogen Division
Allied Chemical & Dye Corp. 11
*Nooter Corporation 94
Norton Company 18

O

*Oakite Products, Inc. 242
*Oil Well Supply Division
United States Steel Corp. 9
*Orbit Valve Company 173

P

*Pacific Pumps, Inc. 224
Pacific Tube Company 5
Palmer Thermometers, Inc. 218
The Ralph M. Parsons Co. 241
The Patterson Foundry & Machine Co. 205
*Peerless Pump Division
Food Machinery & Chemical Corp. 17
*Penberthy Injector Company 56
Perco Division
Phillips Petroleum Co. 204
*Petro-Chem Development Co. 211
Petroleum Electric Power Assoc. 45
*Petroleum Refiner 225, 246
*Petrolite Corp. 55
Philadelphia Gear Works, Inc. 23
Pittsburgh Corning Corp. 43
*H. K. Porter Co. 245
The Wm. Powell Co. 46
*The Pressed Steel Co. 191
*J. F. Pritchard & Co. 27, 237

Q

The Quaker Oats Company 185

R

*Read Standard Corp. 190
*The Refinery Catalog 84
*The Refinery Engineering Co. 192
*Republic Steel Corp. 26, 223
*Revere Copper and Brass Inc. 161
The Ridge Tool Company 200
*Rockwell Manufacturing Co. 60-61
Rockwell Spring and Axle Co. 255
*Rockwood Sprinkler Co. 24, 203

S

*Sarco Company, Inc. 75
Schield Bantam Company 195
Sealol Corporation 169
Service Foundry Division of
Avondale Marine Ways, Inc. 231
The Sherwin-Williams Co. 87
Southern Engine & Pump Co. 231
Sparkler Manufacturing Co. 187
*Standard Steel Spring Division
Rockwell Spring & Axle Co. 255
Stauffer Chemical Co. 230
*Stone & Webster Engineering Corp. Opp. 228
*Struthers Wells Corporation 67
*Sun Shipbuilding & Dry Dock Co. 227

T

*Taylor Instrument Companies 58-59
Tennessee Corporation 244
*The Terry Steam Turbine Co. 220
Texas Pipe Bending Co. 15
Thermo Electric Company 172
The Timken Roller Bearing Co. 6

U

*United States Rubber Co. 243
*United States Steel Corp. 9, 86, 259
United States Steel Export Co. 86
*Universal Atlas Cement Co. 250

V

*Vernon Tool Co., Ltd. 249
*Henry Vogt Machine Co. 247
J. H. H. Voss Company 214

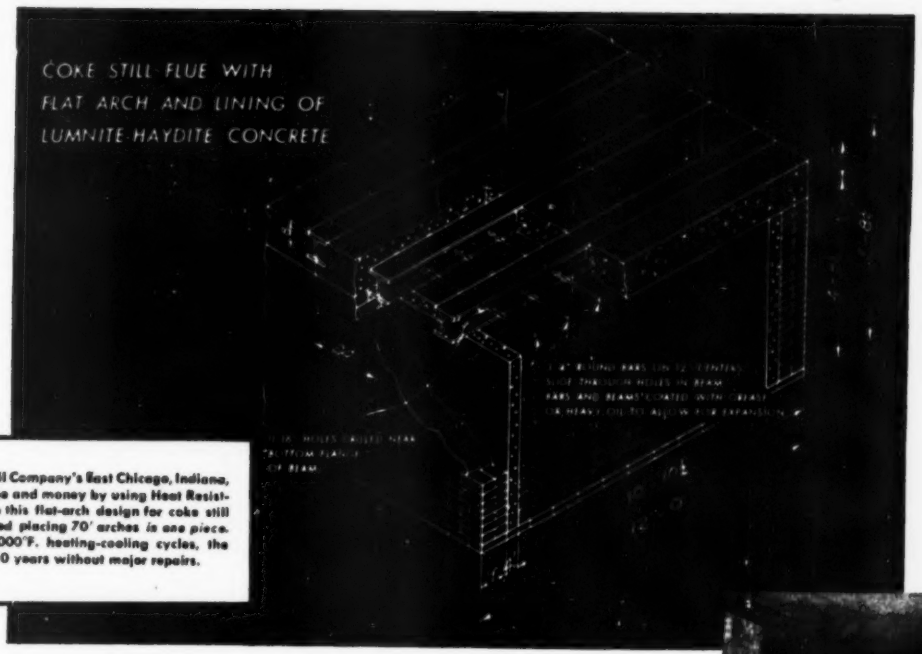
W

Wagner Electric Corp. 80
Walworth Company 82
Warren Petroleum Corp. 233
*Watson-Stillman Fittings Division
H. K. Porter Company 245
*Western Supply Co. 51
*Weston Electrical Instrument Corp. 199
Whitlock Manufacturing Co. 189
*The Gustav Wiedeke Co. 222
*Wolverine Tube Division
Calumet & Hecla, Inc. 179
*Worthington Corp. 21

Y

*Yarnall-Waring Company II Cover
*Otto H. York Co., Inc. 228

Special Industrial Concrete Cuts Refinery Costs



Cities Service Oil Company's East Chicago, Indiana, plant saved time and money by using Heat Resistant Concrete in this flat-arch design for coke still flue. It permitted placing 70' arches *in one piece.* And despite 1000°F. heating-cooling cycles, the arches served 10 years without major repairs.

...resists high temperatures... corrosion... thermal shock

In more and more refinery installations, such as the one shown here at Cities Service, East Chicago, Indiana, plant, costs are being trimmed and efficiency boosted by using industrial concrete where heat and corrosion exist.

In addition to the usual convenience and structural advantages of concrete, special concretes made with Lumnite* calcium-aluminate cement provide:

HEAT RESISTANCE—*up to 2600°F.*

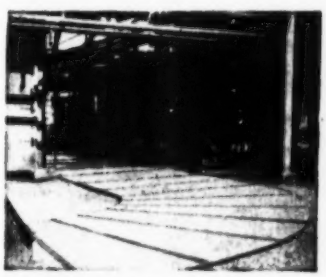
CORROSION RESISTANCE—*with suitable aggregates*

INSULATION—*with insulating aggregate*

Lumnite concrete can be easily placed by plant labor, if maintenance repairs are needed, and is strong enough for service within 24 hours.

Castables for convenience—Make Refractory Concrete with prepared castable mixes of Lumnite cement and aggregate selected for specific temperature and *insulation* requirements—only water is added. They're made by refractory manufacturers and sold through their dealers. For more information, write Universal Atlas Cement Company (United States Steel Corporation Subsidiary), 100 Park Ave., New York 17, N. Y.

TAKES HEAT IN STRIDE—Coke still gases enter the Heat Resistant Concrete flue at a temperature of approximately 1000°F. As you can see, it's still in good condition after a decade of service.



MAKES CURVES EASY—Although the flat arch of this flue curves alongside the coke still, construction was simple with poured-in-place Lumnite Concrete. This plant also uses it for linings in header castings, heaters, stacks, fire doors, vessels of all types and rush concrete work.

**"LUMNITE" is the registered trade-mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.*

PR-L-77R

ATLAS® **LUMNITE for INDUSTRIAL CONCRETES**

REFRACTORY, INSULATING, OVERNIGHT, CORROSION-RESISTANT

A UNIVERSAL ATLAS PRODUCT

U. S. STEEL HOUR—televised alternate Tuesdays—see your newspaper for time and station.

The Petroleum Industry Insists On

HARTZELL Fans for Its Cooling Towers and Heat Exchangers

Hartzite plastic for cooling tower and heat exchanger fan blades was developed especially to meet the rugged requirements of the petroleum industry. After more than ten years of service in the most punishing installations, Hartzite blades have proved themselves beyond all expectations.

What evidence is there of the superiority of Hartzell cooling tower and heat exchanger fans with Hartzite blades? Nearly every Hartzell fan installed since the introduction of the Hartzite blade in 1941 is still in service. And in nearly every case, where one Hartzell fan has been installed on a battery of cooling towers or heat exchangers, more Hartzells have followed as other blades needed replacement.

Fabric-base Hartzite absorbs vibration. Its strength is many times that necessary to withstand normal stresses. Its unusual resistance to corrosion and abrasion is constant throughout the blade. Hubs are of welded steel with an extremely high safety factor.

These are the reasons why Hartzell has become "the" cooling tower and heat exchanger fan in the petroleum industry.

For the complete story, send for Bulletin 1503.

HARTZELL

propeller fan co.

Div. of Castle Hills Corp.

Name _____

Company _____

Street & Number _____

City & State _____

If student, check here for special information ☐

Dept. R

PIQUA, OHIO

PROPELLER-TYPE FANS • BLOWERS
ROOF VENTILATORS • UNIT HEATERS

ENGINEERING OFFICES IN PRINCIPAL CITIES

GRAVER

CONSERVATION TANKS AVAILABLE

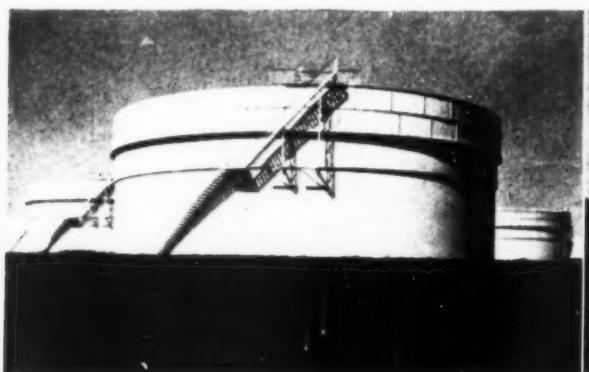
Coast to Coast

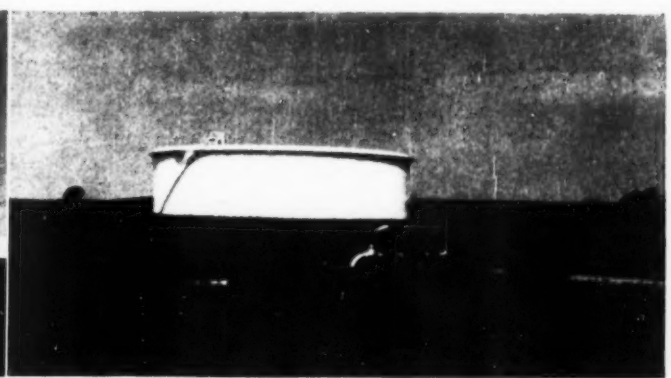
Graver has recently acquired additional facilities at Fontana, California, to serve as another important base for field erection of Graver Conservation Equipment. Now, throughout the country, Graver quality and service are almost literally "at your own back door."

There is a Graver conservation design to suit *your* exact needs. And Graver sales engineers are as close as your telephone. Put our 97 years' experience to work for you!

***the* Graver Expansion Roof Tank** eliminates breathing losses and minimizes filling losses. Its positive liquid seal, exclusive with Graver, protects under all conditions. Ideal for converting existing tankage, and simple to maintain, the Expansion Roof Tank may well protect an entire terminal.

***the* Graver Center-Weighted Floating Roof Tank** combines the economy of the pan-type roof with the stability of the double-deck floating roof. Built to principles of ship design, the roof is stable and will neither sink nor tilt. The entire deck is completely accessible for inspection.





***the* Graver Double-Deck Floating Roof Tank** floats directly on the liquid, preventing the formation of vapors. It is applicable alike to crude and product storage areas at refineries, pipeline terminals and large bulk installations.

GRAVER TANK & MFG. CO., INC.

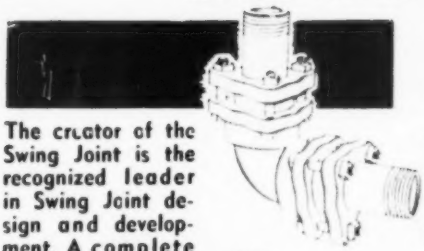
East Chicago, Indiana

New York • Chicago • Philadelphia • Atlanta • Detroit • Cleveland
Pittsburgh • Houston • Catasauqua, Pa. • Sand Springs, Okla.
Odessa, Texas • Casper, Wyo. • Los Angeles
Edge Moor, Delaware • Tulsa

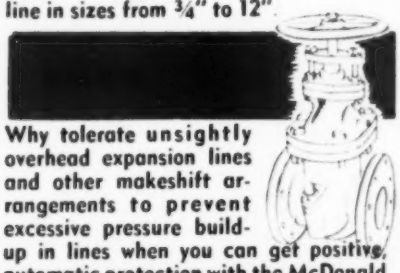
EST. 1856
McDonald

Your Logical FIRST Choice for Oil Handling Equipment

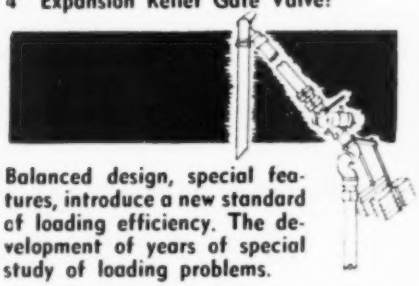
BACKED BY 95 YEARS OF MANUFACTURING EXPERIENCE



The creator of the Swing Joint is the recognized leader in Swing Joint design and development. A complete line in sizes from ¾" to 12".



Why tolerate unsightly overhead expansion lines and other makeshift arrangements to prevent excessive pressure build-up in lines when you can get positive, automatic protection with the McDonald 4" Expansion Relief Gate Valve?



Balanced design, special features, introduce a new standard of loading efficiency. The development of years of special study of loading problems.

For nearly 100 years the McDonald reputation has rested on a solid foundation of completely reliable products—products that combine the latest in engineering with an extra measure of sturdiness that means a generous bonus of service. Where else can you get such positive assurance of the results you look for in oil handling equipment?

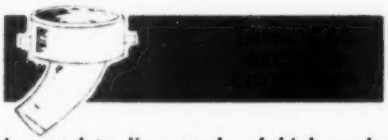
A. Y. McDONALD MFG. CO.

The Home of the Swing Joint

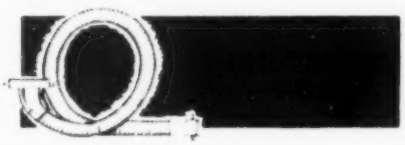
DUBUQUE, IOWA

There's a McDonald Branch or Distributor Near You

Used when loading high-test gasoline—reduces evaporation losses—permits loading rain or shine—eliminates danger of sparks. Saves 2 to 8 barrels of gasoline per car loaded.



A complete line, made of high-grade bronze. Accurate threading assures tight connections. Shipped complete with treated leather gasket and forged steel spanner wrench. Sizes, 5 x 2, 5 x 2½, 5 x 3, 5 x 4 in.



Galvanized flexible steel tank car unloading hose available in 2", 2½", 3" and 4" sizes and in any desired length, complete with couplings.

These Are Representative Items from a Comprehensive Line of Oil Handling Equipment. Write for Catalog.

McDONALD